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RECENT INDUSTRIAL POWER STATIONS

RECENT industrial power stations completed or in progress include work for the following clients: Vacuum Oil Company, Atmospheric Nitrogen Corporation, National Carbon Company, Inc., Pittsburgh Plate Glass Company, S K F Ball Bearing Company, American Sugar Refining Company, Mathieson Alkali Works, Inc., Bethlehem Steel Company, Westinghouse Lamp Company, United States Rubber Company, The Flintkote Company, Pacific Coast Condensed Milk Company, Standard Underground Cable Company, Firestone Tire & Rubber Company.

The work is varied. It includes the building of new steam and power stations, increasing the capacity of present plants, revamping present equipment to meet demands of economy, and rehabilitating old plants.

Illustrated is the Twin Cities Steam Power Plant of the Ford Motor Company at St. Paul.

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

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A Call to Common Sense

PRESIDENT HOOVER is calling American business men into council in order that industry, labor and government may work together in combating the potential effects of the stock-market crisis of the past three weeks. The call is wise and timely. It is an appeal to the common sense of the American business community. Individual business men may have courage and sound sense, and yet the community at large be timid. The council will speak for and to this community.

Dramatic deflation of values such as has shaken the country's stock markets is closely related to the essence of the great depressions of business activity which in past years periodically brought misery to millions. It easily leads to loss of confidence, and when men no longer trust the next day's outlook and no longer trust one another commercial intercourse suffers. Recent years built up the strong conviction that these wave-like depressions need not occur, that production and trade can be maintained at their current level if only the power to consume is maintained. All the machinery of industry has been adjusted to this new creed. Shall the adjustment now be upset by discouragement over paper losses in a stock lottery, or by lack of skill in adapting banking and credit procedures to the event? It need not be.

The history of the world is made up of cycles of expansion and contraction, under conditions often so delicately poised that the advent of a comet, or the birth of a royal child in a remote kingdom, was enough to turn the scale. But in all epochs until the present the industries of production leaned largely on future markets, and were correspondingly the prey of favorable or unfavorable forebodings; hence the great price fluctuations that characterized the prosperity-depression cycles. Today our industries rely less on futures. There are no large accumulated inventories of materials or machines to influence the apprehensions of business men. Phenomenal stability of prices has resulted. With this as a foundation, business should need no magic to maintain itself sound.

The President suggests that deferred public works may be used as a reservoir to maintain productive activity undiminished. But he is not assembling the leaders of private industry and commerce to decide on a public-works program. Their contribution will be to give assurance that American business will not commit the folly of throttling consumption, checking production and unbalancing the adjustment of the entire economic machine. Such a course would but invoke the old-time psychology of a fear complex following upon a wave of speculation.

It is for these leaders to recognize that the great gamble in securities bore no relation to production and consumption, to the effectiveness of the country's industrial and distributory mechanisms, or to the earning power of industry. It is for them to assert and emphasize the fact that the exchange of gains and losses between speculators pro and con brought no loss to the country, just as was learned by even the humblest citizen after the collapse of the frenzied Florida land boom less than four years ago. And it is for them to insist that business credit shall not be contracted or hedged about.

For the country as a whole the outstanding fact is that all our plants, utilities and railways are still there and are producing as efficiently as a month or two ago; that we have as much corn and cotton and cattle as we need and want; that we can build as many houses and roads; and that wages have the same earning power. Each man is ready to labor as actively as yesterday, if only his earning power be not curtailed by discharge from work, by cancellation or curtailment of orders, or by any phase of that business caution—or timidity—which has characterized past eras of contraction.

Will business leaders support this attitude of timidity or will they stand firmly against it? Will they defer the construction of factories and power houses while waiting for the skies to clear? Will cities and states curtail their road-building and other public work? Will bankers hamper the continuance of business activity by restricting commercial and construction loans? Such questions as these address themselves to every element of industry and commerce. They demand prompt and decisive answer. If the answer be clear and unequivocal, the road ahead will be smooth and easy.

Problems of private business are paramount in the present situation. The statistical record does not show that public-works construction has lagged, but in any case business welfare depends on productive industry, and, except as they are productive, public works are a negligible element in the account. In any event, modern ways differ essentially from those of old, when a Pharaoh provided the means of existence for countless thousands by undertaking the construction of a pyramid. And therefore the responsibility for maintaining stable prosperity rests not on the government but on the private citizens who guide commerce, production and finance. In the last analysis it is the responsibility of each individual, for himself and for the business he directs.

Business is the concern of all the people, and government is but its moderator. The council at Washington thus will be a meeting of epoch-making significance. It may attain such a position as to become the equal of legislatures and executives in its relation to the well-being of all. It can go far, even beyond the question of the moment, in developing and improving the nation's industrial and commercial organism. If it enters upon its work with vision and undisturbed judgment, its success is certain.

The President calls upon the common sense of business. Its opportunity is great.

Bonnet Carré Plan Questioned

SOBER reflection is invited by the claim advanced in the present issue that under the official plan now being carried out the Bonnet Carré spillway of the Mississippi flood-control project will cost some ten millions more than would be required at a different location and with radically revised design. The comparison takes into account not only the construction cost of the spillway but also the amount by which others would be out of pocket: the owners of the three railroads, two highways and a gas line which traverse the area, for a secure crossing of the discharge channel. It may not be dismissed lightly as superficial, for the engineer who makes the claim was engaged by one of the railroads affected to make the study which led to the startling conclusion indicated. Moreover, the implied criticism of the official plan involves not only its cost but also the dependability and efficiency of its operation.

The original estimate of $8,200,000 by the army engineers included nothing more than the cost of spillway and its discharge channel; the utilities were to shift as best they could. In fact, it is said that gaps left in the side levees of the channel to pass the railroads were to be closed by sandbags whenever the spillway was to be put in operation, with the effect of interrupting the rail connection of New Orleans with the north. After the spillway had ceased operation the rights-of-way would be turned back to the railroads, whatever their condition after the great flood flow through the channel—whether with only minor washing or with roadbed destroyed.

It is gravely doubtful whether public opinion in New Orleans would ever permit the opening of the spillway if it meant cutting off the city's main supply lines. This was the primary motive of the alternative proposal of a new spillway location, well adapted to the construction of a combination bridge over the spillway. With the change of location, also, the depth of flow at the weir and in the channel was largely increased, thereby narrowing the proposed structures and reducing the cost, while providing more favorable discharge conditions. The proposed layout provides for a single bridge in order that all elements of the problem may be placed under unified responsibility.

Several phases of the Bonnet Carré spillway situation give it an interest beyond the purely technical one of engineering design. Politically it was expedient to build a spillway on the left bank of the river to satisfy the clamors of Louisianians in the Atchafalaya basin, even though that basin could probably have accommodated an additional 250,000 sec.-ft. of flood flow without undue extra cost. The Morganza cutoff, on the west bank, needs more study than the Spillway Board could give, but in any event its construction would have been poor politics. Of the available spillway sites on the east bank, that at Bonnet Carré was reasonably satisfactory and cheap, if the cost of the spillway alone were considered and if a wide spillway with shallow flow were held essential. For a narrower structure, however, the site proposed by Mr. Harris claims strong financial advantages for the government as well as for the utilities.

It is quite possible that the government will be held legally responsible for all damage to railroads and highways resulting from the spillway construction, since the case is subject to the same argument of "additional water intentionally diverted" that was so effectively used in the Boeuf floodway lawsuit. But quite aside from the legal point involved, no plan can justify itself as sound and equitable that does not recognize the rights of all affected persons. It is better business to lay out a scheme in which all the parties are protected and costs are assessed on an agreed basis.

Many interesting engineering questions are raised by the proposal for a revision of location and design. Without venturing to discuss or even to cite them here, we may refer to the problem of erosion in the discharge channel with deep as against shallow flow. Deep rivers tend to have straight channels. Also, a straight stretch of the Missouri River maintains itself between banks of sugar-like silt, and the river's waters, though flowing at as high velocities as those now proposed, do not erode them; and on the other hand, wide and shallow channels comparable to the present official Bonnet Carré discharge channel usually exhibit much meandering due to side erosion. Such factors as these are entitled to careful consideration.

Work has already started on the Bonnet Carré spillway. This affords no argument against restudy of the project, however. The waste that may result from haste is in this case so great that even the government of the United States may well pause for fuller assurance than it now has of the total cost and the efficiency of the enterprise.

New England's Railways

NEW ENGLAND wants to keep its railways independent of trunk line control. To insure this independent status, a consolidation into one system of all of its railways, including those now subject to outside control, is promised. There is sound reasoning behind the proposal. New England's industries in recent years have had to meet the competition of the newer industrial areas of the South and Central West. Those regions offered attractions that could not be met by New England except by concerted action of all of its industries in enhancing the natural advantages of the region and in removing the disadvantages which had developed with the passing years. The outcome of their concerted effort is that New England now is the most closely unified industrial region of the whole country. No industry there lives unto itself. It must understand its neighbor's problem and assist where it can.

The railroads of New England were not unaffected by the same developments. Like the industries, their problems are regional. The Hudson River-Adirondack Mountains barrier serves in large part to keep them separate from the railroad network of the remainder of the Eastern states, and this physical separation has extended generally to corporate relationships. Consequently the railroads prosper or decline as the region prospers or declines, and in turn the rates which the industries must pay for the movement of their raw and manufactured products to and from the rest of the country are major factors in their prosperity.

The independent status which most of the railroads of the region have maintained has helped to keep down rates, through competition both between the Eastern trunk lines in this country for the New England business and between them and the Canadian roads which tap New England from the north. This independence is threatened by a proposed absorption of the New England railways by trunk lines whose larger interests always must remain outside of New England. Their problems are not of New England, and New England sees no possible advantages from such affiliation.

Whatever operating advantages are to be obtained from consolidation may, if necessary, be obtained to the extent that they can be brought about by consolidations within the borders of New England. But the industrial leaders of the region maintain that control of the railways must remain in the hands of men whose success or failure is directly related to the success or failure of the region they serve. This belief is sound. No possible advantage to be gained through making New England's railways part of any system west of the Hudson can offset the advantage of independent action which they now hold.

The Buyer's Part in Improved Steel Fabrication

ENGINEERS everywhere have a vital interest in the outcome of the trade practice conference held by the structural steel industry at Biloxi last week. Once known for individualistic and almost vicious business methods, the structural steel fabricators have made public a united desire to fall in line with modern ideas of commercial relations. Under the helpful, if watchful, eye of the Federal Trade Commission, they have in turn defined and decried the unfair trade practices that have been eating at the roots of their industry. In the words of Judge W. E. Humphrey, of the Federal Trade Commission, they have decided that honesty not only is the best policy but also pays the highest dividends.

In all this that far-flung group encompassing practicing engineers and general contractors, which holds the letting of construction contracts in its hands, has more concern than is at first apparent. Co-operation with the structural steel fabricators involves also much more than a magnanimous gesture of lending the helping hand. Consider some of the things the conference did: It condemned uneconomic and unsafe structural design, pleading for adherence to governmental laws and building codes and for fully dimensioned and detailed drawings, requests that were directed specifically to the designing engineer, since the conference gave very little encouragement to fabricators' designs. It expressed a preference for lump-sum bidding in the interests of economy and fair treatment of buyer and seller. It decried misleading promises of delivery and performance. It branded as unfair all commercial bribery, discrimination and substitution. And finally it condemned the making of uninvited bids and the shopping for or reopening of bids as practiced by some contract-letting agencies.

Successful adherence to these points of the agreement depends as much upon engineers and general contractors as it does upon the fabricators themselves. Let any one of the former countenance skinned designs, inadequate drawings and the receipt of bids "over the transom" with the intent of forcing bids to a lower level, and great harm will be done.

The first moves must come from within the structural steel industry itself. It remains to be seen whether the pledge agreement now so harmoniously entered into will be remembered in days of declining business. Nevertheless, the sincerity and honesty displayed at the trade practice conference created a vision of an industry which has the backbone to live up to its pledges. In view of this, let not the buyers of structural steel do anything, by commission or omission, to throw steel fabrication back to its former state. Every engineer and every general contractor can support the advance now begun.

A Deep Foundation

ENGINEERING features of more than usual interest were involved in building the deep piers of the Lake Champlain bridge, described elsewhere in this issue. Single-wall cofferdams of 98-ft. spliced steel sheetpiles were driven in deep water and through mud and clay to a depth of 97 ft. below the water surface. The methods by which the contractor dealt with the formidable problems of this undertaking testify to his boldness and resourcefulness, and are worth the close attention of every student of construction. That some minor difficulties complicated his operations is no more than might be expected, and in no way detracts from the merit of the achievement.

In this deep construction the employment of divers working in deep water at near freezing temperatures represented a construction expedient far out of the usual course, yet esssential to success in this case. Adding still further to the interesting features of the report is the sealing process used; a seal more than 60 ft. deep was placed in a continuous operation, by means of automatic bottom-dump buckets instead of the usual tremie system. Nearly one-half of the total height of the two deep piers consists of underwater concrete. These interesting features place the Lake Champlain bridge in an exceptional position in the record of foundation work, and add distinction to a public enterprise that is notable alike in financial plan, in engineering design and in construction.

Increasing City Efficiency

NOT often does the average man realize, as the years pass, how greatly the conditions of human existence have been changed by civil engineering development, even within the short space of a decade or two. Most striking of the improvements are those wrought in the efficiency of city life. By making transportation vastly quicker through the construction of pavements, bridges and transit systems, by clearing away dirt, by placing city services of many kinds at the disposal of every dwelling, engineers have indeed transformed the cities of old.

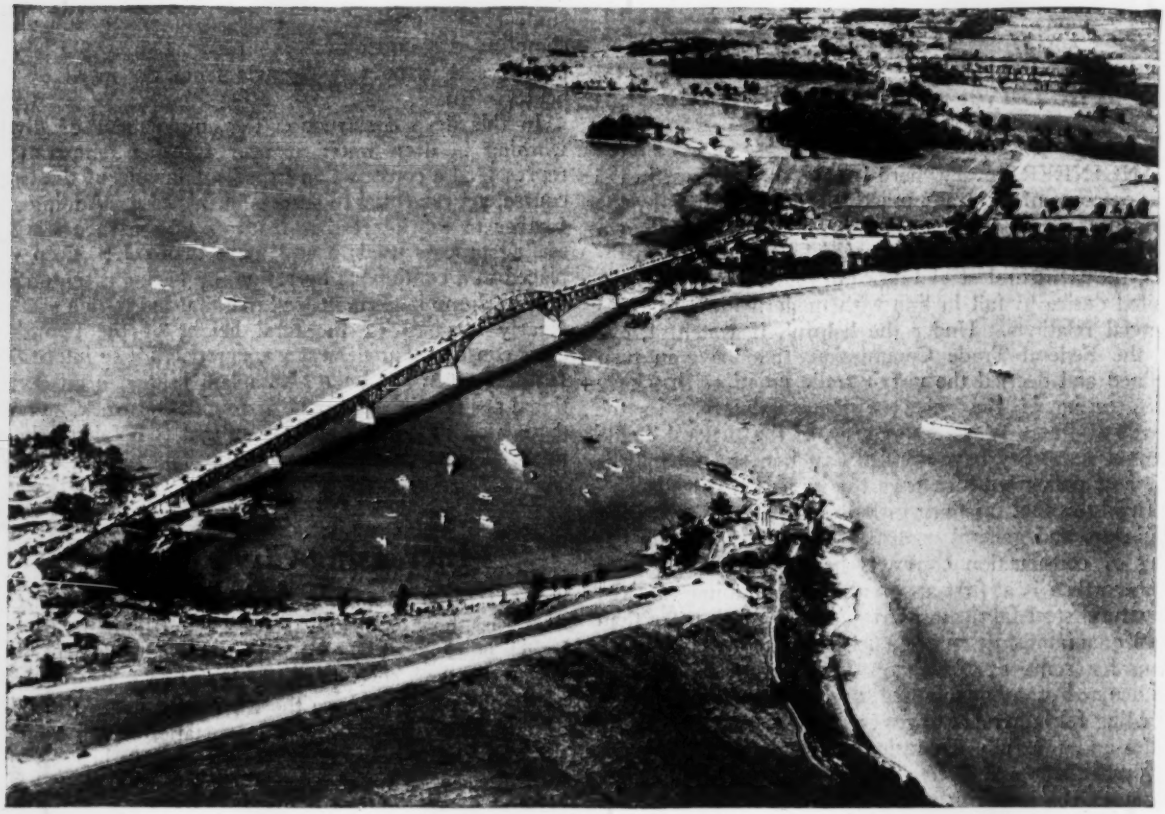
All this involves costs, but costs which are a formidable prospect only when a new project is presented. The cost of works already in service is not felt a burden, for no citizen would be willing to forego the use of these works, and he does not perceive the pressure of their cost. City improvements are paying investments. No single instance comes to mind of an engineering improvement in a modeern city which was later judged uneconomical.

Improvement of a wide river basin which cuts through the city of Dallas, as described this week, affords a present-day illustration of the large issues at stake in the increase of urban efficiency. A cost of many millions must be incurred, but in return a great area of dead ground which now separates two districts will be made available for useful service, and the separated parts of the community will be joined together for much improved intercourse. The dividends which the work will yield will extend far beyond the area directly reclaimed.

There are many opportunities of like kind for remunerative city improvement work still to be realized. In this field the future tasks of civil engineers are large. Fortunately the beneficial possibilities which justify large expenditures for such works are better realized than they were in the past. Public understanding is progressively making the course of engineering development easier.

Deep Foundations for Lake Champlain Bridge Built With Open Cofferdams

Dump Buckets Place Concrete in 97 Ft. of Water for Piers of First Structure Across Historic Lake—Sliding Steel Bracing Used in Cofferdams—Cantilevered Spans Rotated Into Position for Closing



Fairchild Aerial Surveys, Inc.

FIG. 1—AIRPLANE VIEW, LAKE CHAMPLAIN BRIDGE

DEEP open cofferdams with sliding steel bracing were used in building the piers of the first bridge across historic Lake Champlain between Crown Point State Park on the New York side and Chimney Point on the Vermont shore. Concrete placed with bottom-dump buckets sealed the cofferdams 97 ft. below lake level in six-day continuous pours. This steel bracing used in the deep caissons consisted of tiers of framed steel struts and wales, the lower tiers resting on the lake bottom and dropped to, and held at, predetermined levels by rods and cables as excavation progressed downward. Bids on the project were received for both pneumatic caisson and open cofferdam construction, with the low bid favoring the latter type.

The bridge, created as a toll highway project by compact between the states of New York and Vermont, provides the only highway structure across the entire 140-mile length of the lake and is located about 40 miles from the south end and 33 miles south of Burlington, Vt. It was opened to traffic Aug. 26. Approach from the New York side is through Crown Point State Park, between Crown Point and Port Henry, an area containing the ruins of old British and French forts, as well as the Champlain Memorial Lighthouse. The abutment on this side lies within the limits of the ruins of the earlier French fortifications. Across a narrow neck of the lake, only 1,500 ft. wide at this point, the Vermont abutment lies within the ruins of an equally historic French trading post, said to be one of the first in America. The original post house, with its 2-ft. log walls, later veneered with a 1-ft. thickness of brick, is still standing, just off the bridge approach fill.

Design—As can be seen from Fig. 2, the bridge consists of three 50-ft. deck-plate girder spans starting at the New York side, two continuous deck trusses of 225-ft. and 270-ft. spans, three continuous spans of two 290-ft. deck trusses flanking a 434-ft. span rising as a through truss to provide a 92-ft. channel clearance, a simple 270-ft. deck truss and five 50-ft. deck plate girder spans leading to the Vermont abutment. The deck is on a 5½ per cent grade up from each abutment to the channel span.

The abutments are U-shaped concrete structures, and the Vermont embankment approach is held in place by a well-laid dry stone wall. The trusses on the three channel spans are on 30-ft. centers, with the remaining trusses and plate girders on 18-ft. centers. The roadway deck is an 8½-in. concrete slab, 24 ft. between curbs, with

the upper 1½ in. as a separate concrete wearing coat poured monolithically with the structural slab but separated from it by a wide-weave layer of burlap. This design provides for easy replacement of the wearing surface, expected to receive severe traffic wear because of the 5½ per cent grades and the winter operation of cars with tire chains. On each side of the roadway is a double concrete curb 17 in. high and a 3-ft. walk protected on the water side by a woven-wire fence on channel-iron posts.

The plate girders rest on steel bents on concrete pedestals, while the trusses rest on seven standard concrete piers, five of them in water. The two deepest piers are 48x16 ft. in area from El. —2 to El. 72. The cofferdams were sealed to El. 60. At El. 72 the piers step to 44x10 ft. in section, rise vertically to water level and then to El. 130 as slightly battered shafts, with semicircular ends. The water level of the lake is approximately El. 92.5. The other piers are similar in construction, 47x13 ft. in plan at the base, and decrease rapidly in height toward the shore as the lake bottom rises and the roadway gradient falls.

Cofferdam Design and Construction—A feature of the deep pier construction was the use of sliding steel frame bracing in the open cofferdams. The sites of piers 6 and 7 were previously dredged to El. 50, and a single row of spliced steel sheeting 98 ft. long driven inside of a timber guide frame to comprise the cofferdam walls. The bracing for the lower portion of the cofferdams, consisting of four horizontal tiers of framed I-beams, wales and cross-struts, was placed on the lake bottom within the cofferdam. The frames were 6 in. narrower in both directions than the dimensions of the cofferdam to permit sliding downward as excavation progressed. For bracing the portion of the cofferdam above lake bottom, wales and cross-struts were framed of I-beams and channels, with angle-iron posts of crossbracing, shown in Fig. 5. These frames, weighing 10 tons, were handled by two derricks and were hung from timbers placed across the tops of the cofferdams.

Excavating was done by clamshell buckets handled by the same derricks that drove the sheeting. As the excavation progressed the lower tiers of bracing dropped down. As each tier reached its proper level a diver inserted 1¼-in. rods tying it to the tier above. This scheme was used on all the river piers except on pier 8, where ⅞-in. cables running from each tier to the top of the cofferdam controlled the bracing.

No trouble was experienced in getting the bracing to slide downward except in pier 6. On the other piers the excavation had been kept fairly level within the cofferdam, but on pier 6 at one point the excavation in the center was allowed to get about 22 ft. below that on the sides. This caused the sheeting to bulge inward all around and made it difficult to slide the bracing past the bulge. Considerable work by divers was required to get the steel bracing in final position.

Because of the walers, the excavating bucket could not dig close to the walls, and in stiff clay it was necessary for a diver to use a high-pressure jet to trim off the layer of mud, sometimes 2 ft. thick, clinging to the steel sheeting. Much of this jetted material, in a semi-fluid state, was pumped out by 10-in. steam centrifugal pumps. The material excavated by clamshells was loaded on barges and dumped into a shallow bay near the bridge. All of the sheeting, except some on pier 6, was pulled with a special A-frame set on the end of a barge, capable of exerting a pull of 98 tons. All sheeting not pulled was burned off deep under water.

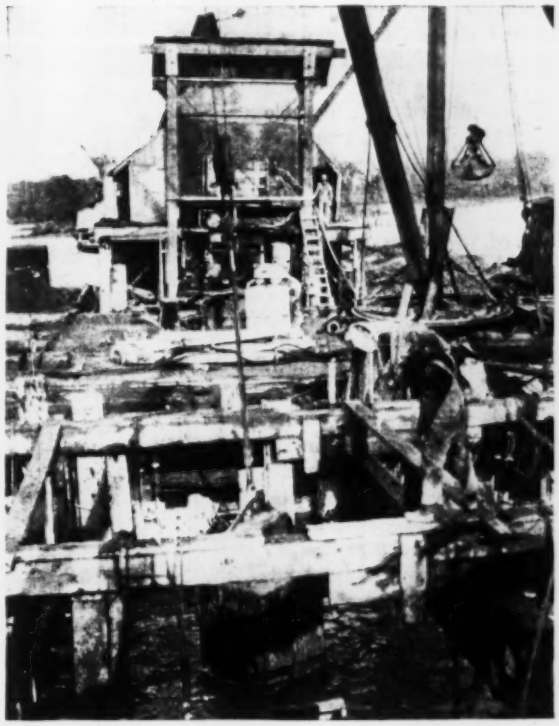


FIG. 3—POURING CONCRETE SEAL FOR DEEP COFFERDAMS WITH BOTTOM-DUMP BUCKET
Cables supporting steel bracing can be seen hanging from timber framing.

Divers inspected the rock bottom after the excavation was completed. In all the piers it was found that glacial action had roughened the ledge sufficiently to require no stepping or chipping. As the work was carried on in midwinter, the divers suffered considerably from cold water and high air pressures required on the deep piers.

Pier Construction—Concreting from the bottom to El. 60 on the two deep piers, and to El. 80 on the remaining piers, was done without pumping out by using a 1-yd. bottom-dump bucket for depositing the concrete. Care was taken to keep the buckets full to prevent wash. The buckets, handled by a derrick boat, dumped automatically as they struck bottom. Fig. 3 shows a bucket of concrete just entering the water. Continuous pouring was maintained on the seal once a pier was started, a six-day run being required for each of the deep foundations. After the seal had hardened, the cofferdams were pumped out and the pier shaft forms were erected and concrete was poured in the dry. The same dump buckets were used in placing the shaft concrete, the bucket being dumped by cross-timbers inside the forms.

FIG. 2—GENERAL ELEVATION, LAKE CHAMPLAIN BRIDGE

Concrete aggregates, both fine and coarse, consisted of iron mine tailings obtained from a near-by mine. These tailings contained a considerable portion of iron ore, resulting in an unusually heavy concrete. For the underwater concrete an approximate 1:1.8:3.6 mix was used, with 6.5 gal. of water per sack of cement. For the shaft concrete 7.7 gal. of water per sack was used, with the proportions approximating 1:2.5:5. Two minutes minimum time in the mixer was specified for the underwater mix, with 1½ minutes minimum allowed on the shaft concrete.

All concrete was handled by a floating plant, consisting of a steam stiff-leg charging derrick, a batcher bin and a 1-yd. gasoline mixer, all mounted on one barge. Aggregates and cement were delivered by barges, with the derrick boat that handled the concrete bucket also unloading cement.

Superstructure Erection—Interesting features of the steel erection were the delivery of material, the ingenious method of closing main span No. 7, the driving of 140-ft. falsework piling and the advantage taken of the continuity of the trusses in erection procedure. Most of the steel was unloaded at a railroad siding on the New York side 3 miles from the bridge site. All of the material unloaded here was trucked during the early winter season over poor roads at their worst. On the Vermont side the steel for spans 9 to 14 was unloaded 15 miles from the bridge site and trucked over equally poor roads with bridges blocked up on the ice to carry the loads. Steel for spans 8 and half of span 7 was carried out over the structure from the New York side, lowered to barges and transported to the Vermont side after the ice went out of the lake.

Four falsework towers of twelve 12x12-in. spliced piles each were driven for spans 4, 6, 8 and 9, as shown in Fig. 2. A tower composed of three falsework bents of ten piles each was driven for span 5, the span being cantilevered out from the New York side to the sixth panel point, blocked on the falsework tower, and then cantilevered to the pier. Span 7 was cantilevered out from each side, closing at the center. Some of the piling reached 140 ft. in length, driven part way before being spliced. Cables stretched between the tops of the piers carrying light timber stringers served as guides for the piles, which were driven by steam hammers hung from the traveler booms without the use of leads. Most of the falsework was erected while the lake was frozen over, the ice serving as a working platform and slots in the ice acting as bottom guides for the piles.

Erection was carried on from the New York side by a light corner derrick traveler, which received its material from a track on top and from the Vermont side by an 8-ton traveling A-frame or "jimmywink" traveler, which received material from barges below. Work was continued through the cold winter months without interruption.

Closing of Span 7—In erecting main span 7, which is

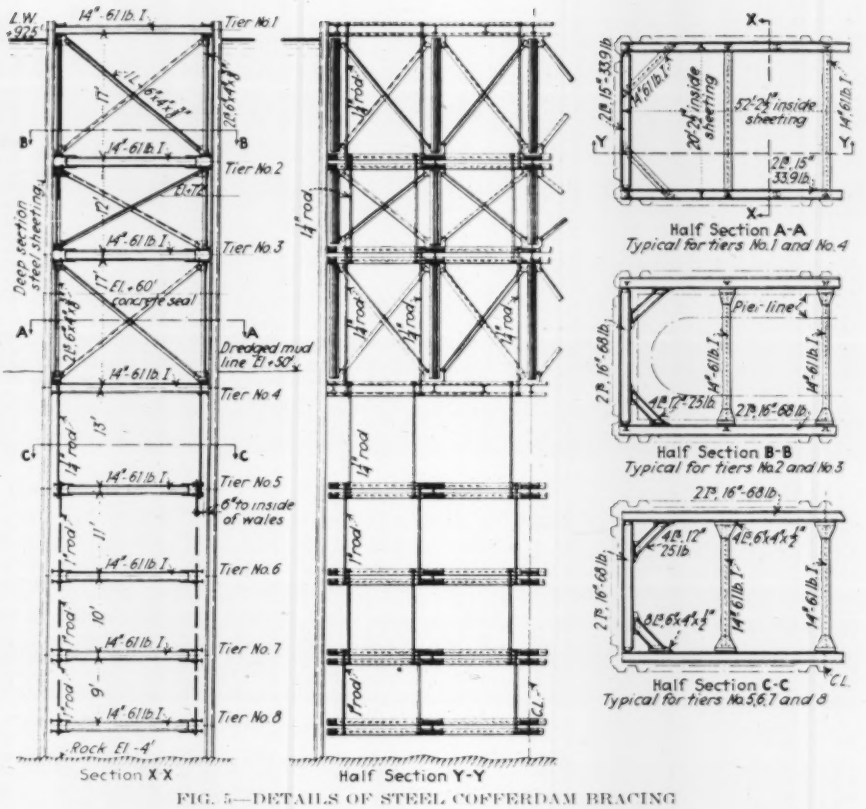


FIG. 5—DETAILS OF STEEL COFFERDAM BRACING

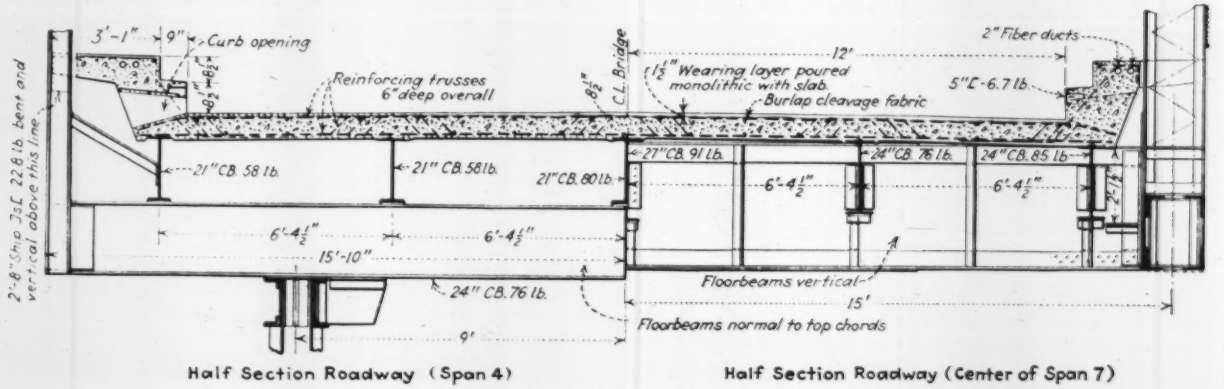

Curb opening
Reinforcing trusses 6" deep overall
2" Fiber ducts
1½" Wearing layer poured monolithic with slab.
Burlap cleavage fabric
C.L. Bridge
Floorbeams vertical
Floorbeams normal to top chords
Half Section Roadway (Span 4)
Half Section Roadway (Center of Span 7)

FIG. 4—TYPICAL CROSS-SECTIONS OF DECK

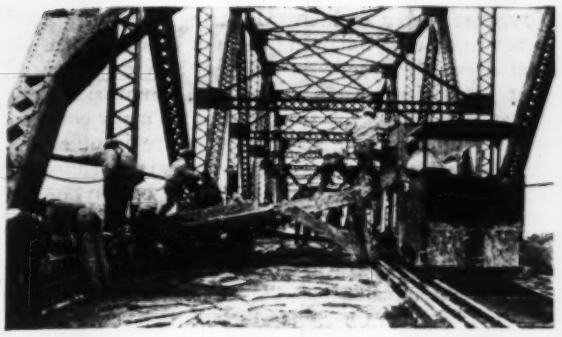


FIG. 6—POURING SIDEWALK AND CURB
Concrete handled by single high cars from central plant.

continuous with spans 6 and 8, closure was effected by keeping the ends of spans 6 and 8 low at piers 5 and 8 respectively, thereby keeping the cantilevered halves of span 7 high until ready to close. Then the low ends of the side spans were jacked up, rotating the two halves about the shoe pins on piers 6 and 7 and bringing the closing ends together. By temporarily omitting the roller nests and a cast-steel filler block in the expansion shoes of piers 5 and 8 the trusses were lowered at these points 20 in., which, through rotation of the spans about the shoes on piers 6 and 7, left an opening of about 13 in. in the top chord and about 7 in. in the bottom chord of the center panel of span 7, which, though subject to change by deflections and temperatures, could be varied by shifting the rocker shoe on pier 7 longitudinally. This shoe was shifted and span 8 jacked up until the bottom chords closed, with the top chords lacking about 1 in. of closing. The two side spans were then jacked simultaneously until the top chords closed, the shoe on pier 7 sliding back again.

When the steelwork was completed, the reactions at piers 6 and 8 for the load then on the spans were calculated and the ends of the structure raised by hydraulic jacks until the pressure gages indicated the desired reactions. The roller nests and cast-steel filler blocks were then inserted under the shoes, and the shoes were blocked to the desired height by steel shims.

Concrete Deck—For pouring the deck the contractor set up a central mixing plant at the end of the New York approach, using mine tailings for aggregates trucked in from the mine. One-half the width of the deck was completed before the other half was started, with the curbs and sidewalks poured separately. Concrete for the deck was delivered in high side hopper cars handled by narrow-gage gas dinkeys, as shown in Fig. 6. Wooden forms supported by horses resting on the bottom flanges of the floor stringers were used for the deck.

A new concrete road connecting the bridge with an existing hard road was built by the state on the New York side. Two unimproved roads lead off from the Vermont end, although the state expects to improve one of these to provide adequate access to the structure.

Personnel—Mortimer Y. Ferris is chairman of the Lake Champlain Bridge Commission, which was created by compact between the two states for the erection of the bridge. Fay, Spofford & Thorndike, Boston, as consulting engineers on the project, designed the structure

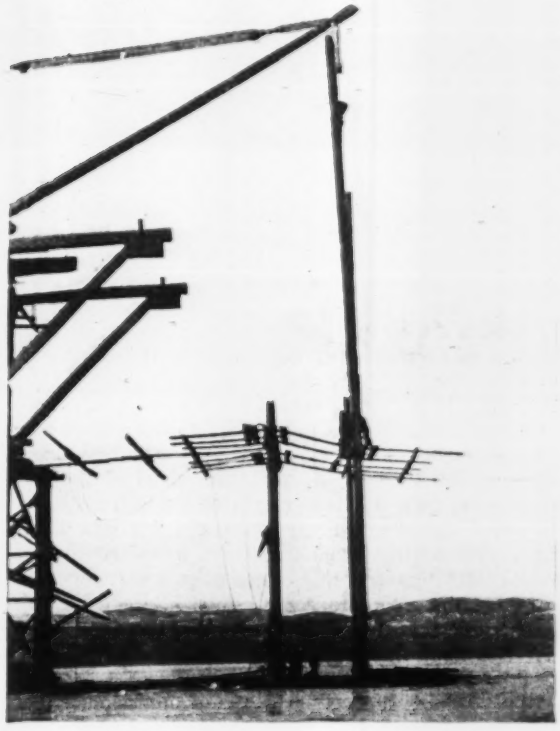


FIG. 7—DRIVING 110-FT. FALSEWORK PILING WITH CABLE GUIDES AND NO LEADS

and supervised construction. George L. Mirick was resident engineer until July 1, succeeded by John L. Lamson, both acting for the consultants. The Merritt-Chapman & Scott Corporation, New York, was contractor on the substructure, which was built under the direction of George Burrows, assistant construction manager, with Fred Logan as superintendent and W. H. Walker as engineer on the job. The American Bridge

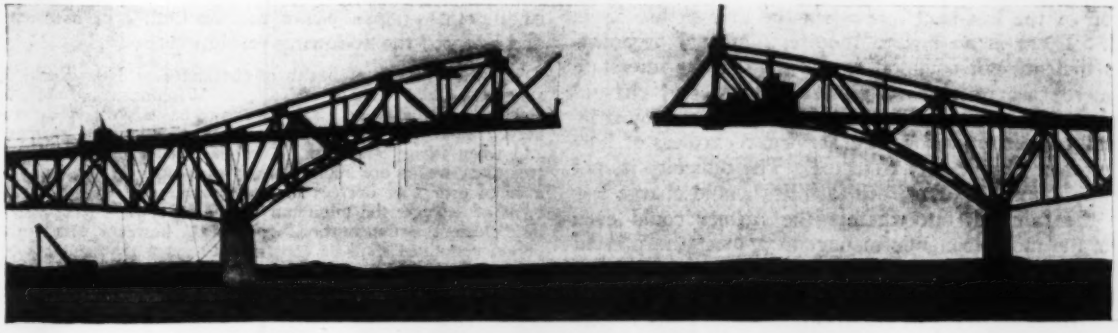


FIG. 8—ERECTION OF MAIN SPAN

Company had the contract for the superstructure, which was carried out under the direction of J. E. Wadsworth, division engineer; H. W. Troelsch, assistant engineer, and J. B. Gemberling, manager of erection. D. S. Fine was erection engineer, with D. M. Wood as foreman of erection. The Scott Bros. Construction Company, Rome, N. Y., was subcontractor on the deck concrete.

Separation of Railroad Terminal Charges Found Not Warranted

Interstate Commerce Commission Finds Present Charges at Rail-Water Terminals No Burden on Traffic

RAIL-WATER terminal facilities at Atlantic and Gulf ports appear to be adequate for normal traffic needs and charges on export, import, coastwise and intercoastal traffic are not so low as to impose a burden upon other traffic, the Interstate Commerce Commission held Nov. 9 in its report on an investigation instituted in 1921 into charges for wharfage, handling, storage and other accessorial services at the ports. The commission found that the record does not warrant prescribing a tariff rule which would require such charges to be stated separately from the line-haul rates on traffic moving to and from the ports. Every effort should be made by carriers when leasing their warehouses to shippers, the commission said, to obtain terms no less favorable than would be obtained under similar restrictions and conditions if the warehouses were owned independently of the railroad.

One of the principal questions at issue was whether segregation of the terminal charges would result in improved facilities for the interchange of traffic at the ports, but the record failed to establish, according to the commission, that the present rail-water terminal facilities have restricted the development of the port terminals or the flow of foreign commerce.

"The record shows," said the commission, "that a separate statement of the port charges by the rail carriers might enable municipal or private facilities to enter the field in affording car-to-shipside delivery at the ports. The carriers, however, would be required to observe their tariff charges, while the municipal or private facility might make varying charges for their services. That situation exists today at south Atlantic and many of the Gulf ports where the port charges are stated separately. Some of those favoring the segregation of the port charges state that the observance of the tariff charges by private facilities for the port service could be assured by having such charges published in the railroad tariffs and collected by the railroad in connection with the collection of the line-haul rate when the private facility is used. There is no law to require municipal organizations that are not common carriers under the interstate commerce act to observe published rates and charges except where the municipal organization is employed by the rail carrier to perform the service, regardless of how the rates or charges are collected. The difficulty is, not that the municipal or private facilities would charge less than the railroad, but whether the former could even under the most economic management meet the present low charges of the rail carriers."

With reference to the question whether the attempt of the railroads to meet the competition of the ports results in charges that are so low as to impose a burden upon other traffic, the commission said that the evidence does not support such a finding. Declaring that this question appears to assume unlawfulness if a railroad earns different degrees of profit on different services or on different parts of the same service, the commission points out that, manifestly, the freight rates on many commodities from interior points to the port are insufficient to cover the mere cost of transfer from cars to shipside at the port. Discussing the contention of private and municipal warehouse and rail-water facilities that charges for the use of railroad-owned facilities are so low that it is impossible for them to meet railroad competition, the commission said that the railroads are under no obligation to make their charges with the view to insuring a profit upon operations of other public terminals and that there can be no violation of the law when carriers fail to place their charges on a basis which will enable their competitors to take away their business. The railroads argued that the terminal services are incidental to the line-haul service and that the charges for such services stand therefore in an entirely different light from those of private or municipal facilities that rely entirely upon the charges derived from the port services for their revenues.

Airway Maps Available

The U. S. Coast and Geodetic Survey is establishing a mailing list in order that those who indicate the desire may be notified promptly when new (or new editions of) airway maps are available for sale. No charge is made for this service. At present, this bureau is publishing airway strip maps to the scale of 1 to 500,000, or about 9 miles to the inch, covering an area 80 miles wide along established airways. These strip maps show streams, roads, railroads, towns and elevations, and emphasize features of importance to air navigation such as airports, auxiliary landing fields, beacons, high-tension lines and magnetic courses. They are compiled from topographic maps of the Geological Survey, highway, post route, state and county maps, and from information supplied by organizations and individuals. Flights are made over the area covered to check the accuracy of the compilation. The Coast and Geodetic Survey is the distributing agency for these maps as well as the strip maps of the air corps of the United States Army. The price is uniform at 35c. per copy with a reduction of 10c. per copy on orders for twenty or more maps.

Steps to Prevent Pollution of the Great Lakes

Matthias Nicoll, Jr., New York state commissioner of health, announces that steps have been taken by the health commissioners of various states to prevent pollution of the Great Lakes. The health commissioners of the states named below met on Oct. 2 in Minneapolis and adopted the following resolution:

The departments of health of the states of New York, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin and Minnesota, signators to the Great Lakes drainage basin sanitary agreement, hereby agree relative to the treatment of municipal sewage that (1) when advice is sought, (2) when plans of municipal sewage-treatment works are submitted for approval, or (3) in the issuance of orders or decrees to municipalities relative to the treatment of sewage, the minimum degree of sewage treatment shall be "efficient sedimentation," provided, however, that nothing herein contained shall be construed to mean that suitable higher degree of treatment may not be required as needed for the protection of the public health nor construed as hampering or interfering with the discretion of each state health department in details of sewage projects such as minor sewer outlets, storm-water overflows and the like.

Hangers Carry Expansion Ends of Long Roof Trusses

With One End of Trusses Free to Swing on a 6-In. Pin at Top of Column, a Possible Movement of 4 In. Is Provided For

By W. S. Wolfe

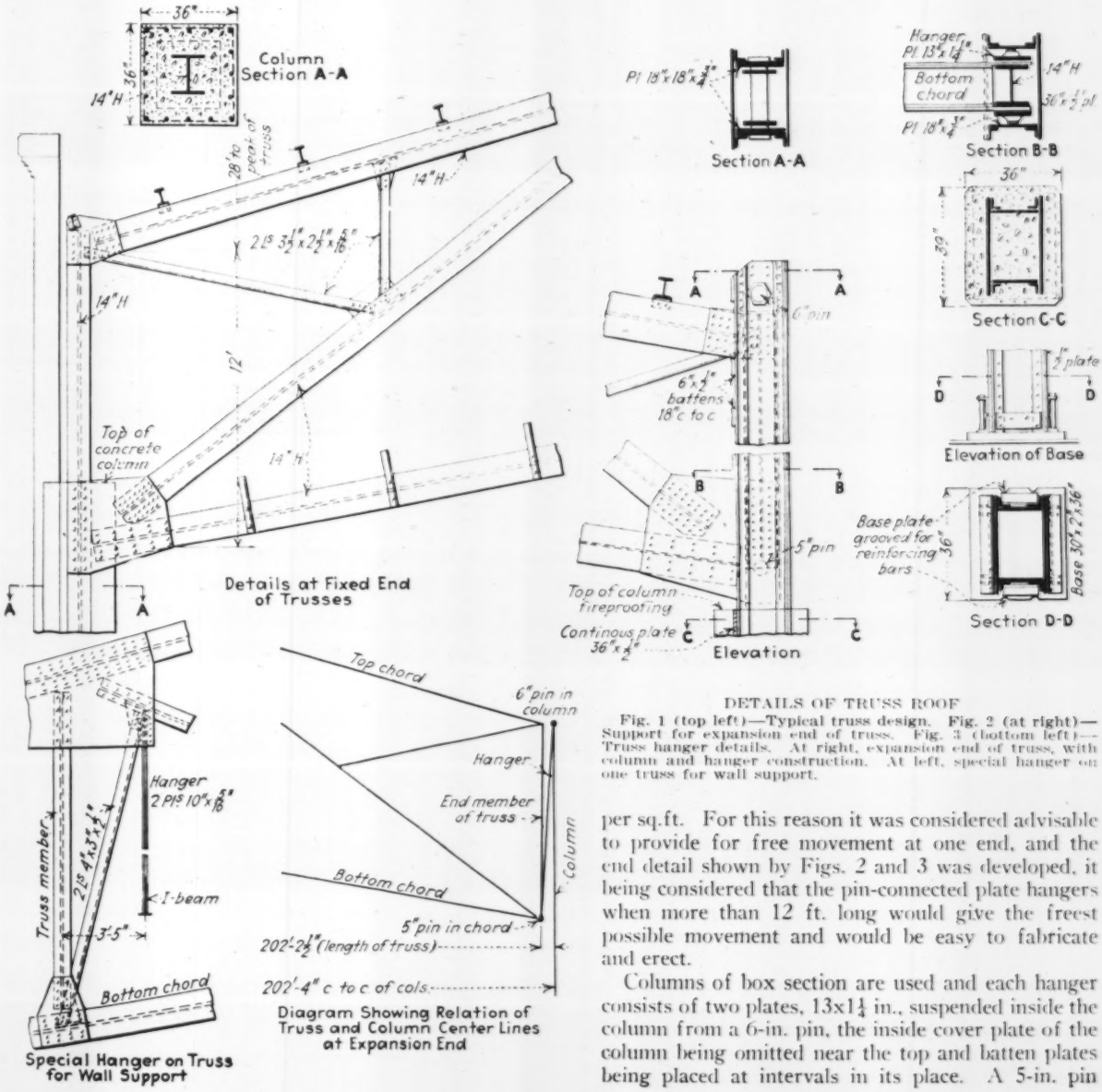
Chief Structural Engineer, Smith, Hinchman & Grylls, Detroit, Mich.

An unusual arrangement to provide for expansion in roof trusses of long span, the expansion ends of the bottom chords being carried in hangers pivoted to the columns, is a feature in the roof of the new auditorium for the Industrial Mutual Association at Flint, Mich.

In this structure (Fig. 4) the roof is supported by six riveted trusses having a span of approximately 202 ft. and panel lengths of about 25 ft. c. to c. As shown by Fig. 1, both chords are composed of heavy 14-in. H-column sections, placed with the web flat and having gussets or connection plates on each flange for the attachment of web members. The main web members are 14-in. I-beams, the others being pairs of angles. In laying out the truss design the aim was to devise a web system that would keep the secondary stresses at a minimum and also give an economical truss. A stress diagram was drawn in the usual way and study of the secondary stresses was made after a preliminary design had been prepared, adjustments being then made as suggested by this study. The depth of truss is 12 ft. at the ends and 22 ft. at the center, the bottom chord having a rise of 18 ft.

When the truss is loaded, not only does the lower chord stretch but the center of the truss is deflected downward. Both of these actions tend to increase the length of the truss and, taken together, account for a movement between 2½ and 3 in. Also, the variation in the length of truss with changes in temperature will be considerable, the maximum total for all conditions combined being about 4 in., assuming a temperature change of 80 deg. and a combined live and dead load of 85 lb. per sq.ft. For this reason it was considered advisable to provide for free movement at one end, and the end detail shown by Figs. 2 and 3 was developed, it being considered that the pin-connected plate hangers when more than 12 ft. long would give the freest possible movement and would be easy to fabricate and erect.

Columns of box section are used and each hanger consists of two plates, 13x1¼ in., suspended inside the column from a 6-in. pin, the inside cover plate of the column being omitted near the top and batten plates being placed at intervals in its place. A 5-in. pin



DETAILS OF TRUSS ROOF

Fig. 1 (top left)—Typical truss design. Fig. 2 (at right)—Support for expansion end of truss. Fig. 3 (bottom left)—Truss hanger details. At right, expansion end of truss, with column and hanger construction. At left, special hanger on one truss for wall support.

passes through the hanger plates and the end of the bottom chord of the truss. For the fixed ends of the trusses, the supporting columns are 14-in. H-beams. A detail of a hanger attached to a truss and supporting an I-beam is shown in Fig. 3. This beam carries a wall near the corner of the building and is supported by a flexible hanger, so that if the truss moves it will not crack the wall.

These trusses were built up in place, one member being erected at a time. Three frames of timber falsework were used for the support of each truss until it was all erected and bolted, ready for riveting. One frame was placed at the center and one at each quarter point. The steel was erected by the Detroit Steel Construction Company. Smith, Hinchman & Grylls, Detroit, Mich., were the architects and engineers for the building.

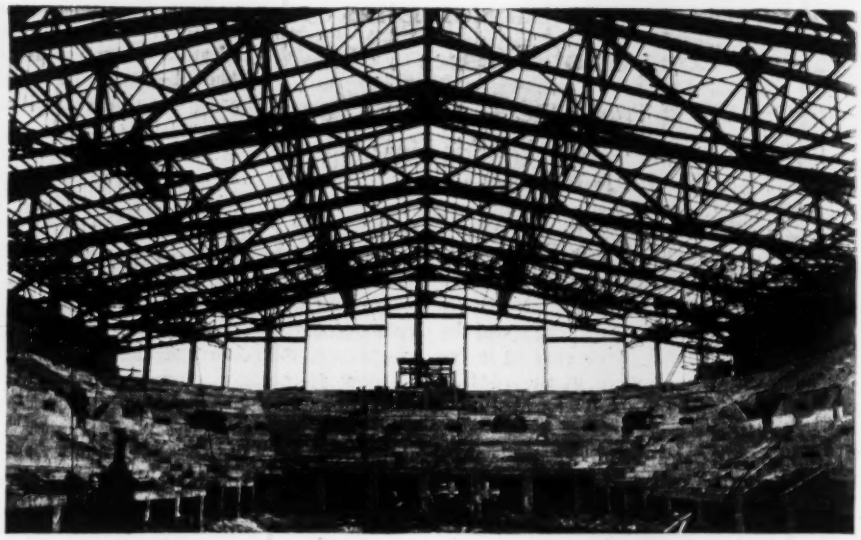


FIG. 4—TRUSS ROOF OF AUDITORIUM, FLINT, MICH.

Operations of the Urbana and Champaign Sewage-Works

FOR the two-year period ended April 30, 1929, the Champaign and Urbana (Ill.) Sanitary District reports a total cost of $1.54 per capita per year for bond retirement, interest charges, operation, new construction and every item of expense incurred for its sewage-works. Operation cost alone, including power, labor, supervision, maintenance and repairs, is 36c. per capita yearly, based on a population of 38,450. The main elements of the plant are the Imhoff tanks and the sprinkling filters.

The average dissolved oxygen for the two-year period in the stream above the plant was 8.1 parts per million; in the plant effluent, 5.5; and in the creek below the plant, 6.8. The corresponding biochemical oxygen demand was 3.04, 25.3 and 8 parts per million. The stream receiving the effluent has an average width of 30 ft. and a flow of from 2 in. to 6 ft. deep.

The bar screens ($1\frac{3}{8}$-in. spaces between bars) were cleaned an average of eight times per day, yielding an average of 3 cu.yd. per month. Scum in the flow channel was skimmed each morning and placed in the nearest gas vent. The grease content from tank 1 is 4.35 per cent; from tank 2, 12 per cent; from tank 3, 12.22 per cent, and from tank 4, 15.86 per cent.

The flow-channel sludge slot was cleaned each week with a chain 6 ft. long on the end of a pole. The slopes of the flow channel were cleaned with a squeegee. The skimmer was used each day to remove the scum from the flow channels. A churner was used occasionally to reduce and loosen scum in gas vents. All tank intake valves were cleaned each month, and it is estimated that 1/9 cu.yd. of rags and débris was removed at each cleaning. There were no marked difficulties of operation, such as foaming and rising of sludge.

Practically all sludge (990 cu.yd. in the first year and 1,110 cu.yd. in the second year) has been removed by country clubs and farmers. The sludge is black and pulverizes easily. The clubs use it as a compost mixture on golf courses. Three sludge beds were resanded in 1928 and eight more will be resanded in 1929.

The filters are 10 ft. deep and operate at a rate of 850,000 gal. daily, giving a loading population of 2,187 per acre-foot. The filter spray nozzles were inspected every day, an average of fifteen needing cleaning. Matches and gum cause the most trouble. Each year all nozzles are pickled in a solution of boiling caustic soda to remove grease. They are then treated with three parts of sulphuric acid and two parts of nitric acid, with the addition of a handful of common salt to each quart of mixture.

The settled-out suspended matter in the secondary settling tanks will ferment, gasify and rise to the surface; therefore a tractor-type sludge scraper is being installed. The lagoon formerly receiving the filter effluent will be used as a stand-by unit.

Grounds around the plant have been planted with flowers and grass so as to attract picnic parties and outdoor gatherings. Nearly 5,000 people have visited the plant during the two years.

Gus H. Radebaugh is manager of the district and Pearse, Greeley & Hansen, who made the original designs, are still retained as consultants.

California to Improve Sharp Highway Curves

Adopting a plan to widen the paving and roadbed on all highway curves of less than 500-ft. radius, the California Division of Highways proposes to improve highway conditions to help meet modern high-speed traffic requirements. The inside of the curves will be widened through a distance of about 80 ft. by a tapered addition that will have a maximum width of 2 ft. for curves of 400-ft. radius, increasing to 4 ft. for curves of 200-ft. radius. The added section will conform approximately to a parabolic transition curve. Inside banks will be cut back where required in accordance with the increased width. This improvement, it is claimed, will increase the visability at curves, provide a more natural curve for driving and afford more passing room, all tending to increase highway safety.

Chile Has $200,000,000 Fund for City and State Public Works

Huge Water-Works, Sewerage, School, Highway, Railway, Port and Irrigation Program, Including More Water for Valparaiso

EMBRACED in a huge program for national and municipal public improvements for which $200,000,000 is available through loans from banks in the United States to the government of Chile is a new water supply for Valparaiso and other municipalities, construction work on which, as on the other improvements, is to be done by the central government, through contractors. To gather data for the design of the Valparaiso water project the government has sent to visit American water-supply systems Edouard Aguirre, of Santiago, who is chief engineer of the department of hydraulics, Chilean Bureau of Public Works.

The additional water-supply works for Valparaiso will be designed under the direction of Mr. Aguirre with a capacity sufficient for a population of 500,000. Valparaiso now has a population of 220,000 and there are 30,000 additional in Viña del Mar, a near-by seaside resort, which, together with several municipalities of 5,000 to 20,000 inhabitants along the line of the aqueduct, are included in the project.

The new supply for Valparaiso will be drawn from the headwaters of River Aconcagua. Studies are yet to be made to determine whether one or two reservoirs will be built, the decision depending upon the relative turbidities of the various headwater streams. It is expected that a storage of 40 million cubic meters, or about 10 billion gallons, will be provided. It is likely that the dam will be of masonry, gravity section.

The aqueduct, which will have a capacity of 2,500 liters per second, or about 57,000,000 gal. daily, will have a length of nearly 200 km., or about 120 miles. Where in rock tunnel the aqueduct will be lined with cement mortar. The other parts will be of plain concrete except that where there is danger of settlement or where inverted siphons are required reinforced concrete will be used. There is at hand plenty of good material for aggregate, lumber for forms, labor for this class of work and good cement, a cement mill being located on the line of the proposed aqueduct about halfway in its length. A main highway and also a trans-Andean railway parallel most of the length of the aqueduct.

A terminal reservoir sufficient for one day's supply will be constructed in or near the city. It will be in excavation and embankment and will not be covered. The new supply will not be filtered, but it will be chlorinated. Head for 10,000 hp. is available, but none will be developed, as a company stands ready to supply all the present demand. Construction will be started in 1931, it is hoped, and completed in five or six years.

The water consumption of Valparaiso is now 120,000 cu.m., or 32,000,000 gal., daily. Water is taken from a small gathering ground near the city. The existing works include both slow and rapid sand filters, the former being used when the consumption is low and the latter when it is high. The water is chlorinated. Among the reasons for providing a new supply are a desire to eliminate the cost of filtration and to avoid occasional bad tastes; another reason is that the present supply is inadequate at times.

Besides the water-works project for Valparaiso, the Chilean government will expend $2,500,000 (American) a year for other municipal water-works projects during a period of six years, funds being available for this purpose. With this money the existing water-works of 70 cities will be improved and works for 36 cities now without a public water supply will be provided. Altogether 71 Chilean cities now have water-works, all of which, except that of Santiago, the capital, need improvement. Of the water-works in operation, those of three cities include slow sand filters and those of three other cities rapid filters. Under construction are slow sand filters for two cities, rapid filters for three cities and a water-softening plant for one city.

There are as yet no sewage-treatment works in Chile, but two plants are under construction, each consisting of Imhoff tanks for a city of about 15,000 inhabitants, one of these being Quilpé and the other Canquene, the latter a suburb of Valparaiso.

Besides the public works already mentioned, the Chilean government has a program for building railways, highways, sewers, irrigation works, port improvements and school buildings, in accordance with a plan formulated by the present administration and approved by the Chilean Congress. North American bankers have provided a fund of $190,000,000 for these improvements, including the $15,000,000 already mentioned for the six-year water-works improvement program outside of Valparaiso but not including the water-supply project for that city.

The following American contractors are at work for the Chilean government: the Foundation Company and the Ulen Contracting Company, New York City, and the Warren Brothers Company, Boston, on buildings, dams and roads, respectively, all on a cost-plus basis.

Notable Water Meter Record at San Francisco

Few water meters were found to be running either fast or slow as a result of tests made during the entire year 1928 by the Spring Valley Water Company, of San Francisco. In accordance with a rule of the company, consumers' meters are tested on complaint of inaccuracy provided that after examination of the plumbing and related matters by an inspector of the company, no explanation of the claimed over-registration is found. Tests are first made on the premises with the aid of a measuring tank holding 10 cu.ft. In a paper read before the recent meeting of the California Section of the American Water Works Association, V. E. Perry, manager of water sales department, Spring Valley Water Company, summarized 1928 tests as stated further on. It should be noted that the San Francisco water supply is 100 per cent metered. Mr. Perry said, in conclusion: "During 1928, out of 102,413 active metered services, we tested only 494, or about 0.5 per cent. Of these 494 meters tested, 217, or 43.9 per cent, were found to be 100 per cent efficient; 193, or 39.1 per cent, were found to be slow; and only 84, or 17 per cent, were fast. Of the 84 fast meters 42, or 50 per cent, were 1 per cent fast; 21, or 25 per cent, were 2 per cent fast; 16, or 19 per cent, were 3 per cent fast; and 5, or 6 per cent, were 4 per cent fast. In accordance with our rules, we refunded for the above fast meters the sum of $71. As our gross revenue for 1928 was $6,565,450, our refunds on account of fast meters of $71 were only about 0.001 per cent of our 1928 revenue. This we believe to be a very favorable showing."

Dallas Reclaims 10,000 Acres in the Heart of the City

Leveed Channel Will Confine Trinity River and Provide Large Areas for Industrial and Commercial Expansion—Project Involves Moving About 17,000,000 Cu.Yd. of Earth and Construction of Pumping Plants and Sluiceways

By Albert S. Fry
Assistant Engineer, Morgan Engineering Company, Memphis, Tenn.

A FLOOD-PROTECTION project now under construction at Dallas, Tex., will reclaim 9,940 acres of land in the valley of the Trinity River. As this land is subject to overflow, it has constituted a barrier separating the main part of the city on the east side from Oak Cliff and West Dallas on the west side, where about one-third of the city's population lives. The condition with the river in moderate flood and at an elevation of 37.6 on the gage in December, 1928, is shown in Fig. 1, but the record flood (1908) was 15 ft. higher. A general plan of the project is given in Fig. 2.

Flooding has occurred too frequently to permit profitable development of any except the higher lands around the rim of the area, where overflows occur least often. This reclamation is being undertaken primarily for industrial and commercial purposes, with incidental residence development in parts of the area. On both sides of the valley the present business and industrial districts may readily be extended down into the reclaimed area.

Topography and Drainage Area—Within the limits of this project the valley is about 7 miles long and 1 to 4 miles wide. Its lands are generally flat, with slopes increasing around the borders of the project to meet the steeper surrounding hillsides. Surface slopes lengthwise of the valley vary from 2 to 3 ft. per mile to practically level. Near the middle of the area the Elm Fork and West Fork of the river unite to form the main Trinity River. These streams wind in tortuous channels through the flood plain and carry the ordinary flow, but are insufficient to carry any appreciable flood discharge. Above Dallas the drainage area is 6,050 square miles, of which 2,684 are on Elm Fork and 3,366 on West Fork. Excepting the valleys of the two forks, the drainage area is generally rolling.

FIG. 1—TRINITY RIVER IN MODERATE FLOOD, DECEMBER, 1928

New levees shown by black lines planned to eliminate such overflow and reclaim bottom lands for industrial development. Crossing in foreground is electric railway bridge. Next is the Oak Cliff viaduct, the only high-water crossing. Above this is the union station, then the Commerce St. bridge and the Texas & Pacific Railroad crossing. At the upper right, outside the curve in the Rock Island Railroad, is the Turtle Creek pumping station of the city water-works.

Floods—Daily stages in Trinity River at Dallas have been kept by the U. S. Weather Bureau since 1903. Earlier records of the highest floods have been preserved back to 1844. Flood stage is 25 ft. on the gage. The four largest floods on record had 50.7 ft. gage height in 1844, 49.2 ft. in 1866, 47.4 ft. in 1871 and 52.6 ft. in May, 1908. It is estimated that the peak discharge during this latest and largest flood was in excess of 200,000 sec.-ft. but did not exceed 250,000 sec.-ft. Its water line is indicated in Fig. 2. West Dallas was overflowed and all railroad service cut off, while basements in the business section were flooded by backwater. Damage was estimated at $2,500,000. Recurrence of such a flood at the present time would cause much greater damage, because of changes and improvements within the flooded area.

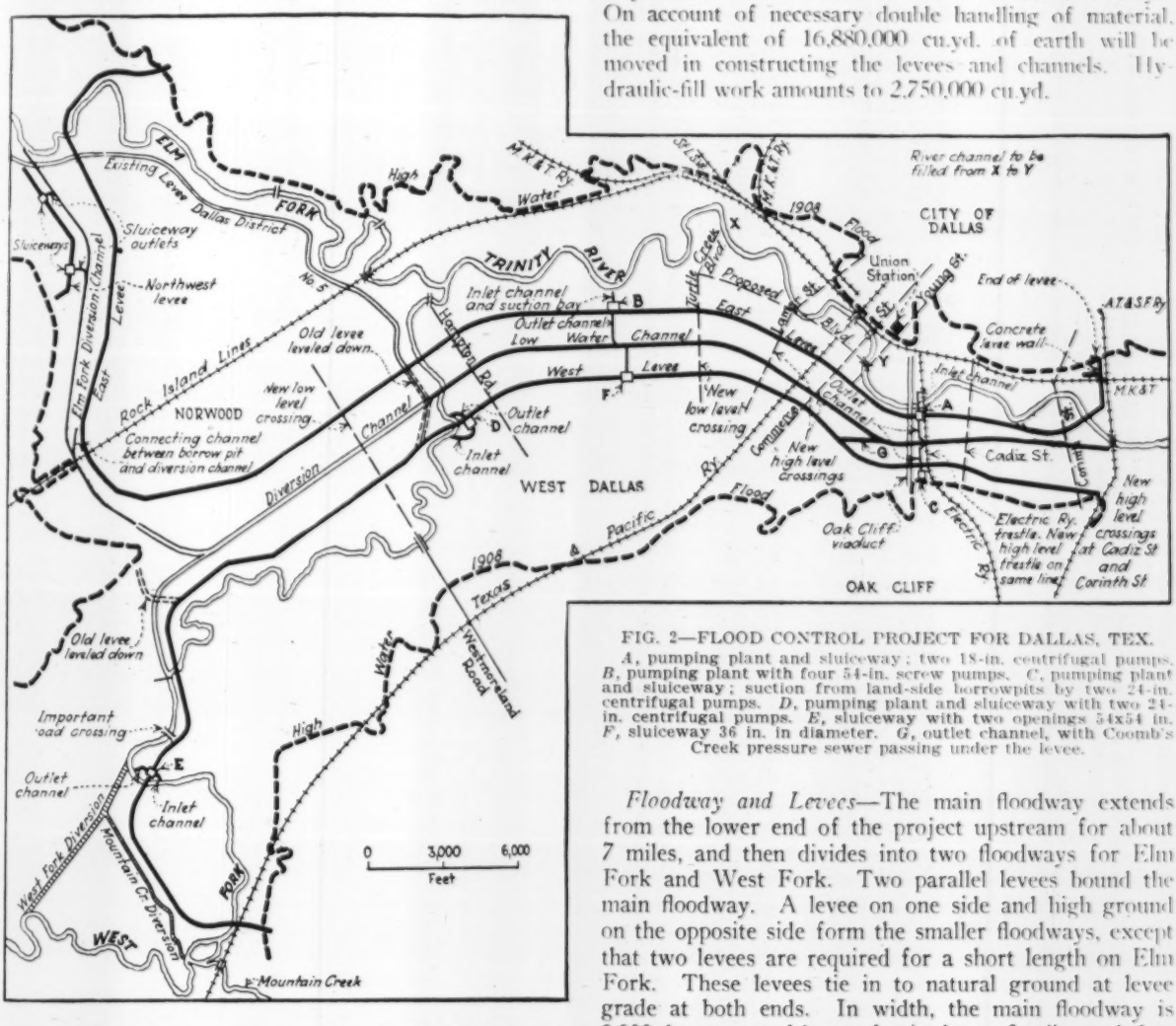


FIG. 2—FLOOD CONTROL PROJECT FOR DALLAS, TEX.
A, pumping plant and sluiceway; two 18-in. centrifugal pumps. *B*, pumping plant with four 54-in. screw pumps. *C*, pumping plant and sluiceway; suction from land-side borrowpits by two 24-in. centrifugal pumps. *D*, pumping plant and sluiceway with two 24-in. centrifugal pumps. *E*, sluiceway with two openings 54x54 in. *F*, sluiceway 36 in. in diameter. *G*, outlet channel, with Coomb's Creek pressure sewer passing under the levee.

Organization of Project—Above the confluence of Elm Fork and West Fork the area between the two streams was organized in 1918 as Dallas County Levee Improvement District No. 5. This district constructed a levee high enough to protect against ordinary floods and to reclaim the land for agricultural purposes. In April, 1926, the City and County of Dallas Levee Improvement District was organized and the two districts co-operated on a joint plan to give complete flood protection in both districts.

Flood-Protection Works—Under the flood-protection plan, floodwaters will be confined within a leveed floodway. The old channels of the three streams are cut off by the levees, while diversion channels will deliver the ordinary flow of the two forks to the floodway extending through the city and discharging into the present river channel. Pumping plants and sluiceways, together with storage in the old channels and borrowpits, will care for runoff from and through the reclaimed area.

This plan will require 26 miles of floodway levees, 15 miles of diversion channels and 2 miles of auxiliary channels. Levee embankment will amount to 10,400,000 cu.yd. and new channel excavation to 2,320,000 cu.yd. On account of necessary double handling of material, the equivalent of 16,880,000 cu.yd. of earth will be moved in constructing the levees and channels. Hydraulic-fill work amounts to 2,750,000 cu.yd.

Floodway and Levees—The main floodway extends from the lower end of the project upstream for about 7 miles, and then divides into two floodways for Elm Fork and West Fork. Two parallel levees bound the main floodway. A levee on one side and high ground on the opposite side form the smaller floodways, except that two levees are required for a short length on Elm Fork. These levees tie in to natural ground at levee grade at both ends. In width, the main floodway is 2,000 ft. c. to c. of levees for its lower 3 miles and then widens in 1.7 miles to 3,000 ft., which is maintained up to the junction of the two fork floodways, which have minimum widths of 1,500 ft.

This floodway is designed to have a capacity approximately double the discharge of the 1908 record flood. Its entire area is to be cleared and maintained clear. For 2.7 miles beyond the lower end of the district the valley is to be kept clear for a width of 3,000 ft. in order to lower the water level at the outlet of the floodway. In the northwest corner of the district a small agricultural area is protected by a separate levee which will be 11 ft. lower than the east levee on the opposite side of the floodway but will protect the land against ordinary floods, so that farming operations can be carried on. Rare and extreme floods will overtop this levee and afford a wider floodway at this location.

A typical cross-section of the main levee is shown in Fig. 3. It was adopted after consideration of the short

duration of floods in the Trinity River and of the available materials for construction. Floods are at crest only a few hours and recede entirely within a comparatively few days, not lasting long enough to saturate the levees and cause seepage. Most of the material available is impervious in either the levee or its foundation for any period of time during which a flood stands against it. An addition of 20 per cent is made to the net volume of fill to allow for shrinkage. In height, the levees vary from 18 to 33 ft., with an average of 28 ft.

Soil borings were made under the levees and in special cases over the borrowpit areas to determine the character of the subsoils. Sand and gravel found under parts of the levee were usually underlain by exceptionally hard, impervious clay locally known as shale. In such cases a core trench is excavated down to the shale and backfilled with impervious material in order to form a cutoff to prevent seepage under the fill. In general, two-thirds of the material for the levee is taken from the reclaimed side borrowpit, the rest being taken from the floodway pit and shallow berm stripping. The limiting depth is 15 ft. for floodway borrowpit and 18 ft. for reclaimed side pit.

Varying subsoil conditions necessitate some departure from the typical cross-section, so far as borrowpits are concerned. For 1¼ miles upstream from the lower end of the east levee all material is to be obtained from the reclaimed pit, in order to prevent erosion that might occur in a borrowpit at this location due to velocities caused by the drop-off curve of the water surface at the floodway outlet.

In its lower section the west levee is underlain at a depth of about 8 ft. by a 6-ft. stratum of sand on the rock. As this levee extends through a built-up part of Oak Cliff, where right-of-way costs were high, the borrowpit on the reclaimed side was eliminated except for a short distance, where a shallow pit was excavated. In co-operation with the city of Dallas and Dallas County, a concrete storm sewer is being constructed along this section to furnish drainage. The levee material was obtained from a borrowpit on the floodway side, leaving a 300-ft. berm beyond the toe of the levee and borrowing only 3 ft. deep for the next 100 ft.

Part of the west levee is on a sand ridge which could not be cut off by a core trench, and here no borrowpits were permitted. Material for the levee is being transported in wagons hauled by crawler tractors from the floodway, a banquette being built on the reclaimed side wide enough to produce a ratio of water travel to water depth of 20 to 1. The floodway side of this levee is shown in Fig. 4.

FIG. 4—FLOODWAY SIDE OF LEVEE

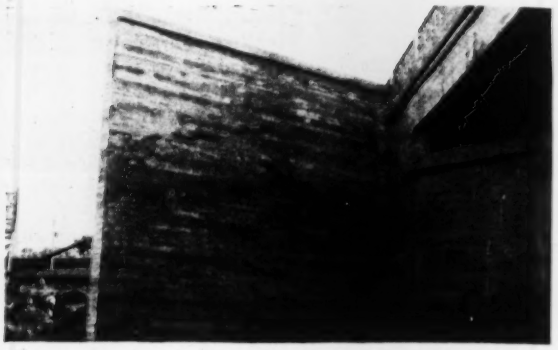


FIG. 5—CUTOFF WALL IN LEVEE AT BRIDGE

Where the new levee crosses the old river channels a banquette is built on both sides of the levee, the width being 75 ft. on the floodway side and 50 ft. on the reclaimed side. As the west levee intersects the concrete abutment of the Oak Cliff viaduct, a concrete key wall (Fig. 5) is recessed into the abutment face and extended 25 ft. into the levee for the full depth of the abutment, to prevent seepage along the masonry.

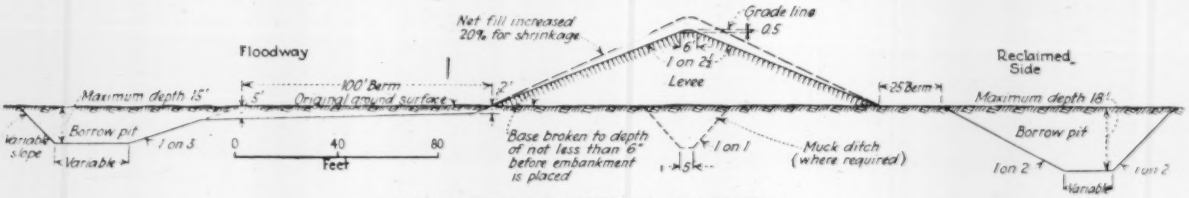


FIG. 3—TYPICAL SECTION OF LEVEES

At its downstream end the east levee intersects the Santa Fe Railway and the Missouri-Kansas-Texas Railroad 7 ft. below levee grade. On account of the railroad tracks, an earth levee could not be built and a concrete wall is substituted, with openings at the track crossings to be closed by stop planks during extreme floods. To support these planks, structural steel posts in each track and between tracks will be set in wells in a concrete sill extending under the railroad.

Embankments, floodway side berms and the floodway borrowpit slope nearest the levee are to be sodded with Bermuda grass, which discourages weeds and resists erosion. Living sprigs of Bermuda grass are placed 2 ft. c. to c. in rows also spaced 2 ft. c. to c., the sods being then covered with 1 in. of earth.

Diversion Channels—As built, the diversion channels are smaller and of less depth than the old river channels, but it is expected that these new channels will be enlarged and deepened by erosion. Observation of small excavated pilot channels in other parts of the Trinity River valley, in soils like those at Dallas and under similar conditions of flow, has demonstrated their enlargement to much greater sections of capacity in excess of the old river channel.

The new main diversion channel is being excavated with a bottom width of 15 ft., side slopes of ¾ on 1, average depth, 20 ft. The West Fork channel has 5 ft. base width, 1 on 1 side slopes and 22 ft. average depth. The Elm Fork diversion channel will have a base of

35 ft., side slopes 1 on 1 and an average depth of 20 ft., the wider base being used on account of the very flat character of the land, and the possibility of erosion being less rapid than on the other channels. All berms are 20 ft. wide between the margin of excavation and toe of spoil bank. This width permits the banks to cave and the material to wash down stream, enlarging the channel so that when the spoil banks begin to cave no detrimental obstruction of the channel is likely to occur.

Water was diverted into the West Fork diversion channel about Nov. 15, 1928, the flow being returned to a part of the old channel which will be in the new floodway. This new channel is 1.4 miles long, whereas the old channel is approximately 4.5 miles from the head to the outlet of the diversion. Enlargement has taken place rapidly in this channel since its excavation, as shown by Fig. 6. The sequence of channel construction is worked

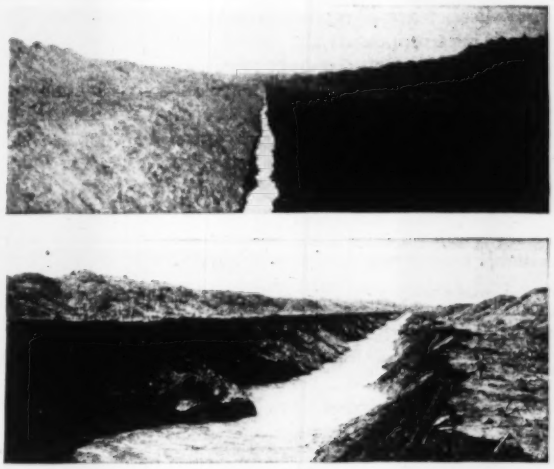


FIG. 6—WEST FORK DIVERSION CHANNEL
Above—Channel as excavated. Below—Channel as enlarged by erosion in four months.

out so that the upper portions, where erosion would ordinarily take place last, are being constructed first, wherever temporary deep outlets can be secured in the old river channels. These upper sections will thus have a chance to erode and enlarge to the grade of the old channel temporary outlets before the latter are finally cut off by the new floodway levees.

Pumping Plants and Sluiceways—Storm runoff from the reclaiming areas will drain normally under the levees by gravity into the new diversion channels through reinforced-concrete sluiceways and connecting channels. With the river in flood and gravity drainage thus cut off, runoff behind the levees will be collected and stored in the old river channels and the land side borrowpits, to be removed by pumping or stored for gravity flow after the flood has receded. Without this utilization of the old river channels and the borrowpits as storage basins for interior runoff, which is an essential part of the plan, the size and cost of pumping plants would have to be increased greatly. To take care of runoff from surrounding lands, the city has authorized the construction of four pressure storm sewers. These will begin at the flood level elevation and extend as closed pressure conduits across the district to outlets in the floodway.

There will be four pumping plants. The largest will be equipped with four 54-in. screw pumps, each operated by a 350-hp. motor. Two stations will each have two 24-in. vertical double open suction centrifugal pumps driven by motors of 125 hp. and the smallest station will have two 18-in. centrifugal pumps operated by 80 hp. motors. Power will be purchased from the Dallas Power & Light Company. An area at the upper end of the west levee has no pumps, as there was sufficient capacity in the old river channel and borrowpits within this area to store the storm runoff during flood times. This water will be drained out through a sluiceway after the flood has passed. The area protected by the northwest levee will be drained in the same way through sluiceways by gravity. All sluiceways will be provided with mechanically controlled sluice gates and all except the largest station will be equipped with automatic gates as an additional precaution to prevent water backing into the storage basins in the event of a quick rise in the floodway before the main gates are closed. The mechanical gates at the pumping plants will be electrically controlled, and those at the sluiceways will be manually controlled. Concrete collars 3 ft. wide extend outside the sluiceways at 20-ft. intervals to intercept any seepage.

Hydraulic Fill—Material will be pumped from the floodway to fill the old Trinity River channel for 2¼ miles immediately adjacent to the business district and to fill some depressions to the general level of adjacent land. In addition, hydraulic fills will be placed around the heads of the three new floodway crossings to bring

FIG. 7—LEVEE CONSTRUCTION WORK
Above—Walking dragline building west levee. Below—7-yd. crawler wagon hauled by 10-ton tractor. Skyline of city at left

the adjoining lands to the elevation of the bridge approaches. These fills will slope back on easy grades from the approaches to meet the natural ground surface.

A complete street and storm sewer layout has been made for this area, to be constructed as development proceeds. The cost of the hydraulic fill has been assessed against the lands benefited, which are to be developed for high-class industrial and commercial uses.

Construction Equipment—The levees and channels are being constructed with nine dragline machines and four crawler tractor wagon outfits (see Fig. 7). Seven draglines are of the walking type and two of the crawler type. Two have 6-yd. buckets on 100- and 125-ft. booms, two have 4-yd. buckets on 100-ft. booms, and four have 3-yd. buckets on booms 65 to 80 ft. long. One small dragline carries a 1-yd. bucket on a 45-ft. boom. The tractor wagons are rated at 7-cu.yd. capacity and are drawn by 10-ton tractors. These wagons are loaded by the small dragline and are used on the section of west levee where levee material is hauled in from the floodway. Trucks were used on a part of this work. A suction dredge will be installed for the hydraulic filling.

Progress—Construction work was started in July, 1928. A time limit of 700 working days is specified for all work except the hydraulic fill, which has a limit of 900 working days. About 35 per cent of the work was completed by July 1, 1929. Work has progressed on the west levee so that the area reclaimed by it may be entirely protected by the end of the present season.

Corollary Construction—Adjacent to the main business section of Dallas and Oak Cliff, the Trinity River flood waters will be confined between levees to a width less than half that of the previous overflowed valley. This reduced width has made it economically possible for Dallas County to construct four new highway bridges. This has been impossible before because of the high cost of the long structures. These four bridges, now under construction at Corinth, Cadiz, Commerce and Lemar Sts., will relieve traffic congestion on the present high-level viaduct between Dallas and Oak Cliff.

In addition, roads are to be constructed by the county across the floodway and over the levees at Turtle Creek Boulevard, Westmoreland Road and Hampton Road, with a high-water trestle at Irving Road. Approaches to the viaducts will also be built. Hard-surfaced highways are to be extended through the reclaimed area to form connecting links in the county highway system, which were not feasible in the unprotected overflow valley. The city has voted bonds for constructing five underpasses beneath the railroad tracks that line the eastern bluff and to extend five city streets, which now end at the tracks, into the reclaimed area to connect with the new bridges.

Utility Adjustments—Under the Texas reclamation law, public utilities are required to make changes at their own expense to conform to the works of an improvement district. As the new floodway is crossed by the Texas & Pacific Railroad and the Northern Texas Traction Company on trestles which are below levee grade, bridges are to be built by both utilities with underclearance at levee grade. The Rock Island Railroad crosses the new Elm Fork floodway on a low embankment which is to be replaced with a bridge at levee grade.

Several oil and gas pipe lines are being reconstructed to pass over the levees and under the borrowpits and channels. Some small lines have been permitted to remain under the levees after concrete seepage collars were constructed around the pipes. City sewers are being reconstructed under the levees with collars to intercept seepage and with cutoff valves to prevent back flow in case of a break in the sewer in the floodway during high water. Adjustment in power lines, telephone and telegraph lines are being made by the owners as construction requires.

Contracts and Costs—The construction work was divided into fourteen contracts, all of which were let May 12, 1928. Under the Texas law, no contract for construction work in a levee improvement district is valid until contracts for all works required have been awarded. The principal unit prices are as follows: Embankment in levees, 20c. per cubic yard; embankment for river fills, 32c.; channel and core trench excavation, 12c.; hydraulic fill, 30c.; clearing, $40 per acre; grubbing, $100 per acre; concrete, $21 per cubic yard; reinforcing steel, 5c. per pound; sodding, $500 per mile.

Costs were assessed in each of the two co-operating levee improvement districts as follows: The City and County of Dallas Levee Improvement District reclaims and benefits 6,812 acres at a total cost of $6,000,000, or an average of $880 per acre of reclaimed land. Since the area is intended for commercial and industrial development and other city uses, this cost is better expressed on a square foot basis. The cost per square foot of reclaimed land, without deduction for streets, alleys, railroad reservations, etc., varies from a maximum of about 19c. to a minimum of about ¼c., the former being for property nearest the Dallas business district and within the area to be especially improved and the latter for property most remote from the business centers. In the Dallas County Levee Improvement District No. 5 there are 3,128 acres protected at a cost of $500,000, or $160 per acre.

The cost of the works to be constructed by the city and county and which have been made possible by the levee project amount to about $6,000,000. Including the costs to be borne by the utility and railroad companies in conforming their properties to the improvements, a total of about $13,000,000 is to be expended.

Engineers and Contractors—The engineers for the larger district are Myers, Noyes & Forrest, Dallas, Tex. E. L. Myers represents the two districts on a co-ordinating committee of city, county and levee interests. E. N. Noyes and T. C. Forrest, Jr., are directly in charge of construction. The Morgan Engineering Company, Memphis, Tenn., is consulting engineer and also designed the improvements. Ned H. Sayford is in charge for this company and the writer is assistant engineer. H. W. English is resident engineer and also represents the consulting engineers on the construction of the project. Valuable co-operation has been given by B. F. Williams, state reclamation engineer. The Trinity Farm Construction Company, Dallas, Tex., is general contractor for the entire work, with J. D. Kirven, general manager, in charge of construction. The district is governed by a board of supervisors serving without compensation: J. J. Simmons, chairman; Leslie A. Stemmons and W. J. Wyatt.

Strength of Brick Walls Determined by Bureau of Standards

The Bureau of Standards, in co-operation with the Common Brick Manufacturers' Association, has just completed a comprehensive series of strength tests of masonry. The results of these tests appeared in the October issue of the Bureau of Standards *Journal of Research* and answered many questions for which heretofore there has been no authoritative answer.

The tests showed that brick walls which had been kept damp for one week after they were built were no stronger at the age of 60 days than similar walls allowed to cure in the laboratory. They showed that higher strengths can be obtained by having the horizontal mortar beds smooth and level, eliminating all trowel marks and having all joints filled. When the strengths of several of the recently developed types of hollow walls were divided by the allowable working load permitted by building codes governing masonry construction, an ample factor of safety was obtained. The relation between brick strength and wall strength and between the strengths of walls of different size was investigated.

Careful records were kept of the material used in the walls and the time required to build them. These data, showing the saving in brick, mortar and time for all the types of hollow walls, as compared with solid walls of brick of the same thickness and coupled with the strength tests, give information which will be of assistance to prospective builders in selecting the type of wall for their homes.

Steel Fabricators Hold Record Meeting

American Institute of Steel Construction Sponsors Trade Conference at Which Fabricators Make a Start Toward Better Business Methods—Convention Program Develops New Column Slab Design and Introduces a Welded Steel Floor to the Industry

Engineering News-Record Staff Report

THE STRUCTURAL STEEL industry was never in better condition than it is at present, said Charles F. Abbott, executive director of the American Institute of Steel Construction, in his report at the seventh annual convention of the Institute in Biloxi, Miss., last week. Certainly, a more important or significant meeting of the steel fabricators has never been held. The attendance of 300 was larger than ever before. The trade practice conference, held with the help of the Federal Trade Commission, constituted an important milestone in the industry's history. Several noteworthy papers were read, and one on column slab design presented especially valuable data. So far as the Institute itself is concerned, the work of its new corps of district engineers, which centers on the extension and development of markets for structural steel, stood out in bold relief. As a crowning achievement on the program, a model of the "battledeck" steel floor developed by the Institute's chief engineer was erected on the hotel grounds with the aid of a new automatic arc-welding machine. The meeting convened with a pronounced feeling of optimism regarding the structural steel industry in the immediate future and for the "long pull."

Reports of President and Executive Director

Charles N. Fitts, of the New England Structural Company, president of the Institute, pointed out how structural steel shipments have continued to gain in spite of a seasonal recession in the total bookings of the steel mills. Mr. Fitts made several important recommendations—namely:

1. That preparations be made for a semi-centennial celebration of the invention of the skyscraper in 1934.

2. That the federal government be petitioned to create in the Bureau of Standards a division to diagnose demolished buildings.

3. That an expert investigation be made of the effect of the tall building on taxation, health and society.

4. That the Bureau of the Census be requested to enlarge its current statistics so that trading areas can be measured for basic commodities such as structural steel.

Mr. Abbott in his report as executive director stated that estimated consumption of structural steel during 1929 was 3,955,880 tons, as against 3,072,300 tons in 1928. Other developments are a cause for optimism: The information service of the Institute is steadily increasing; greater co-operation among competitors and better business methods are in evidence; the Institute's standard specification is being incorporated in an increasing number of city building codes; the code of standard practice is receiving wider acceptance, and the trade practice conference, held at this year's convention, should provide an added impetus; 55,000 copies of the Institute's Handbook of Steel Construction have been distributed and orders are being filled at the rate of 75 to 100 copies per day; the district engineers, under F. H. Frankland, manager of technical service, are playing an important part in the increased use of structural steel.

In conclusion, Mr. Abbott stressed the fact that the individual concern can prosper only as the industry prospers. This involves the extension of markets and the development of new ones, but it also involves an appreciation of the fact that extreme faith in mass production is not a cure-all. It must be remembered that the fundamental principle of mass production is that "the complete output must find an immediate profitable sale." The capacity of the fabricating plants being greater than present demands makes proper handling of this question a necessity for the structural steel industry.

Artistic Bridge Competition

The award for the most artistic steel bridge completed during 1928 was made to the Sixth St. suspension bridge in Pittsburgh, and was received by V. R. Covell and A. D. Nutter, respectively chief engineer and design engineer, Bureau of Bridges, Allegheny County, Pa. A similar award will be made for 1929, except that two bridges will be selected, one costing less than $200,000 and the other more than $200,000. The student competitions for the most artistic bridge design will be continued, with the important change that prizes will be awarded to engineering students, as well as to architectural students.

Trade Practice Conference

The most important and significant phase of the program was the trade practice conference which preceded the regular convention sessions. It is reported that approximately 75 per cent of the structural steel fabricating industry was represented by delegates. W. E. Humphrey, of the Federal Trade Commission, presided, but in his own words was "present only as an interested observer."

The usual trade practice conference procedure was followed. A committee appointed last December under the chairmanship of R. T. Brooks, of the George A. Just Company, presented a set of resolutions or rulings to the conference. These rulings were divided into two groups. In the first group were listed those practices which are unlawful or believed to be unlawful involving such things as: (1) the substitution of materials inferior to those specified; (2) the use of unlawful methods of manufacture and erection; (3) selling below cost with the intent of injuring a competitor; (4) dumping; (5) secret payment or acceptance of rebates and concessions; (6) dissemination of false or misleading information relative to a competitor or his products; (7) submitting a bid after contract has been let, with intent of injuring a competitor, and (8) price discriminations. The second group of rulings involved practices believed not to be unlawful but known to be uneconomic and bad for the industry. These resolutions placed the structural fabricators on record as condemning: (1) uneconomic and unsafe designs; (2) misleading promises of delivery and performance; (3) the practice of submitting a bid without having been invited to do so; (4) the practice of

reopening bids on the part of contract-letting agencies, a procedure which amounts to shopping for bids. Also there was expressed a preference for lump sum bidding as a system most fair to buyer and seller alike.

The rulings were unanimously indorsed by the conference, and will be referred to the Federal Trade Commission for an opinion as to the correctness of the grouping. A document will then be presented to the industry for it to sign, putting the resolutions into official effect. Incidentally, the resolutions provide for an industry committee which will investigate alleged unfair trade practices, regulate them when it can and refer them to the Federal Trade Commission when it cannot.

Views on Recent Specifications

Lee H. Miller, chief engineer of the Institute, in his annual report was outspoken in his condemnation of certain clauses in the new highway and railway specifications being developed jointly by the various technical societies. Specifically, he objected to the "double-headed" unit stress which specifies 16,000 lb. per sq.in. for live load, and 24,000 lb. per sq.in. for dead load, but permits increasing the specified live load by such a percentage that a 24,000-lb. combined unit stress can be used. "This subterfuge," said Mr. Miller, "is expected to avoid unpleasant conversation on the part of public officials and railway executives who lack engineering training and experience, but it will also mislead many of engineering training and react against the use of these specifications." Wheel load concentrations as a method of measuring live load also were criticised by Mr. Miller, who recommended simplified loadings covering present and probable future traffic vehicles. Providing for impact by an empirical formula that approximates tests made on certain types of spans is inadequate. In Mr. Miller's opinion, "the difference in deflection of a static live load and a moving live load is a measure of impact and indicates that a proper impact formula should be a modified deflection formula and should include factors representing length of span, moment of inertia or depth and coefficient of elasticity." In concluding his remarks Mr. Miller said: "On the whole, these specifications are most excellent, but the compromises indicate that they will not be generally acceptable, although they will be of value in developing various individual specifications. It is, of course, unfortunate that the fabricating industry has no specifications, along which uniform practice can be promoted."

Other significant statements in Mr. Miller's report were: that failure of the fabricator to develop welding will make possible and necessary another subcontractor between the fabricator and the general contractor; that when the mills exercise the option of furnishing open-hearth or bessemer steel in filling an order, they should, if bessemer is furnished, assume responsibility for defects that cannot be detected except by fabrication and service; that a proper definition of dimension tolerances should exist for structural shapes; that wind pressure and deflection instruments similar to those installed in the American Insurance Union Building in Columbus, Ohio, are to be placed in one or two of the tall structures now under erection in New York City; that the Institute should offer to supply the Bureau of Standards with equipment for a thorough research into fire resistance and sound conductivity of materials used in steel structures.

The steel floor developed by the Institute's staff, comprising a composite T-section of 3- to 12-in. I-beams and $\frac{3}{16}$- to $\frac{1}{2}$-in. plates, electrically welded together, was discussed and a sample floor was built in the hotel yard. Views of the sample floor and of the special automatic self-propelled welding machine developed by the General Electric Company are shown in Fig. 1. The floor was described in *Engineering News-Record*, Aug. 29, 1929, p. 326. In connection with the sample floor, special gypsum fireproofing sections were shown by the Rockwood Corporation of America, St. Louis, Mo. Ceiling sections are hooked directly on the lower flanges of the beams, while special sections incase the girders, and an interlocking unit is used to incase the columns.

Preceding a demonstration of welding on the "battle-deck" floor, a discussion of both welding and riveting was held. Frank P. McKibben, of the General Electric Company, and J. C. Lincoln, of the Lincoln Electric Company, discussed respectively the metallic and the carbon arc-welding processes. Professor McKibben, in addition, explained the design methods and assumptions that have proved successful on the several arc-welded structures that have so far been completed.

Need for Restudy of Rivets Cited

Riveting practice was presented by A. F. Jensen, of the Hanna Engineering Company, manufacturer of compressed air equipment. Mr. Jensen showed, by means of lantern slides, the remarkable development that has taken place in riveting machine design. He also called attention to the fact that no new technical data have been presented on riveted joints in the past fifteen years. "Dependable as it is, the time has come to restudy the riveted joint," said Mr. Jensen. He suggested that such a study should include stress distribution and concentration, eccentric loading, maximum limit of rivet pitch adjacent to a calking edge, effect of calking riveted joints by welding, tolerance of rivet and hole diameters, merits of various types of joints, rivet shape and head, cold riveting and a comparison of joints driven at varying pressures, with an increase in the time pressure is sustained on the rivet as driving pressures decrease. In referring to cold rivets, Mr. Jensen called attention to the fact that a leading fabricator is driving rivets up to

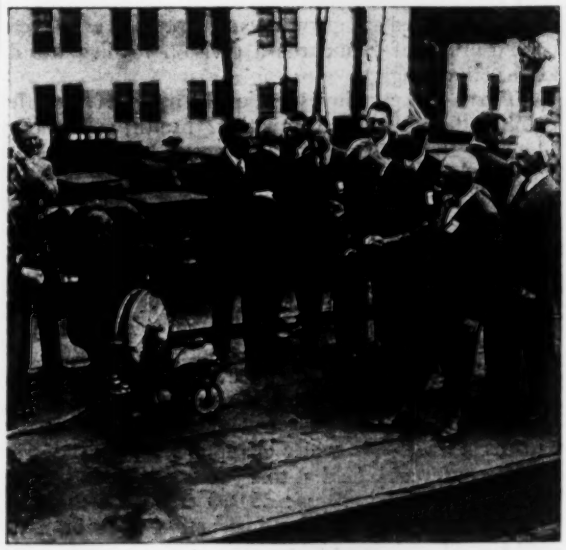


FIG. 1—CONSTRUCTING SAMPLE PANEL OF WELDED STEEL FLOOR

Members of A.I.S.C. see a new automatic welding machine fabricate plates and supporting beams into a composite T-section floor.

1-in. diameter cold in building columns, forming a full button-head on the rivet. Mr. Jensen is of the opinion that cold forming is not injurious, and pointed to the fact that on practically all rivets $\frac{7}{8}$ in. or under the manufactured head is formed cold.

Steel Bridges, Steel Dams and Lock Gates

In an address on "Fifty Years Progress in Bridge Building," Dr. D. B. Steinman, consulting engineer, New York City, gave a comprehensive review of many of the famous bridges, from the Brooklyn bridge down to the present time, when new records of span length and erection speed are being recorded on such structures as the Detroit and Mount Hope suspension bridges, and the Chesapeake & Ohio Railway continuous-truss bridge at Cincinnati. Doctor Steinman, with the aid of lantern slides, reviewed such outstanding structures as the Eads tubular arch bridge at St. Louis, the Hell Gate arch bridge at New York City, the Forth cantilever bridge in Scotland, the Quebec cantilever bridge, the Carquinez Strait cantilever bridge in California, and the Florianapolis eyebar suspension bridge in Brazil. One of the unusual comparisons cited was the 96 hours required to lift the suspended span of the Quebec cantilever into place in 1917, as contrasted to the 35 minutes required for a similar operation on the Carquinez bridge ten years later. Doctor Steinman's design for a proposed suspension bridge of 4,500-ft. span across the Narrows at the entrance to New York harbor was also briefly reviewed. The theme of Doctor Steinman's paper was "beauty in steel," without recourse to other materials and without unnecessary adornment.

Henry Goldmark, consulting engineer, New York City, a veteran in the field of steel structures for resisting hydrostatic pressures and the designer of the Panama Canal and New Orleans ship canal locks, addressed the convention on the subject of "Steel Dams and Lock Gates." Mr. Goldmark recalled that three steel dams varying in length from 180 to 680 ft. and in height from 46 to 81 ft. were built in the United States between 1898 and 1907. Of these three, one, the Hauser Lake dam in Montana, failed from undermining of the foundation. The remaining two dams are reported to be in good condition with no indication of corrosion. Mr. Goldmark also reviewed the use of various types of movable dams in river regulation and showed many lantern slides of the design and construction of the locks of the Panama Canal.

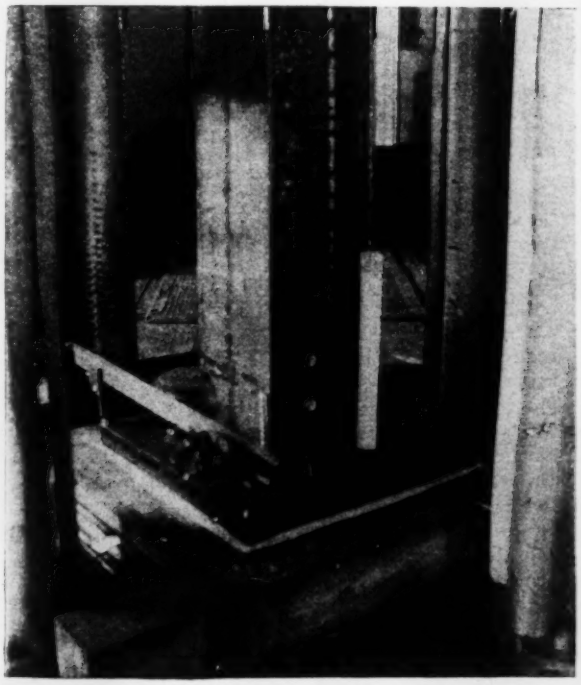


FIG. 2—SET-UP FOR TESTING STEEL COLUMN SLABS

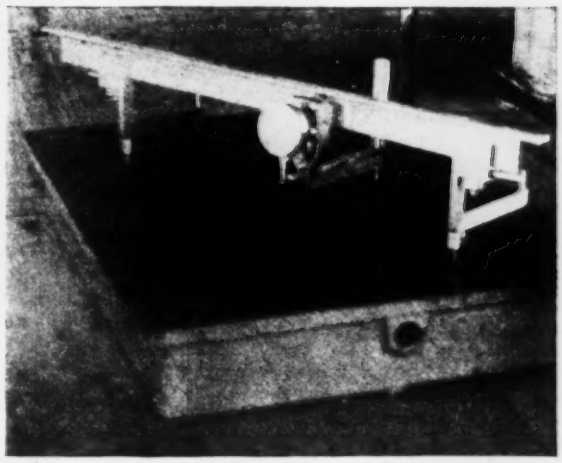


FIG. 3—DEFLECTOMETER USED TO MEASURE SLAB DEFLECTIONS

Designing Steel Slabs for Column Bases

An important piece of research work on steel column slabs, together with a radical revision of design methods for these important members, was reported by Kenneth G. Merriam, assistant professor of applied mechanics, Worcester Polytechnic Institute. Whereas usual practice predicates slab design on the assumption that the column load is concentrated on the four outer corners and that the web area of the column is practically relieved of pressure by the dish action of the slab, Professor Merriam's investigations indicate that there is a decided tendency on square slabs for the slab to bend more about the axis coinciding with the column web than about the other principal axis, and this, coupled with other indications, he believes constitutes strong evidence that the load of the column approaches uniform distribution. Revised design methods based on this assumption were presented.

The experiments were carried out with full-sized test specimens—8-in. 32-lb. rolled I-section columns, machined slabs 18x18 in. with thicknesses of 2 and $1\frac{1}{2}$ in. respectively, and a base designed to duplicate the action of a crumbling footing and consisting of a pressure box filled with standard Ottawa sand. The set-up in the 400,000-lb. testing machine is shown in Fig. 2.

As a corollary to the test, an instrument capable of showing the shape assumed by the slab under load was developed and termed a slab deflectometer (Fig. 3). It consists of an ordinary Ames dial attached to an investigating point contact, the whole mounted on a graduated scale. When the instrument was used to investigate slab deflections, the scale supports on either end were placed on the corners of the slab so that all readings are referred to these corner points. The operation of the instrument required obtaining zero from a flat machined plate. During the tests the deflectometer was passed over the slab at every 25,000 lb. of load, and for loads above 125,000 lb. the load was relieved after each traverse to investigate the slab for permanent set. The load

deformation relation for each point was plotted as shown in Fig. 4. The slopes of these load-deformation curves—the load rates of deformation—expressed in half-thousandths of an inch per 100 kips of load were then plotted as shown in Fig. 5, the contour lines representing lines of equal load-rates of deformation. In other words, Fig. 5 shows the shape assumed by the slab under load.

The striking feature of Fig. 5 is a noticeable tendency for the slab to bend more about the axis corresponding

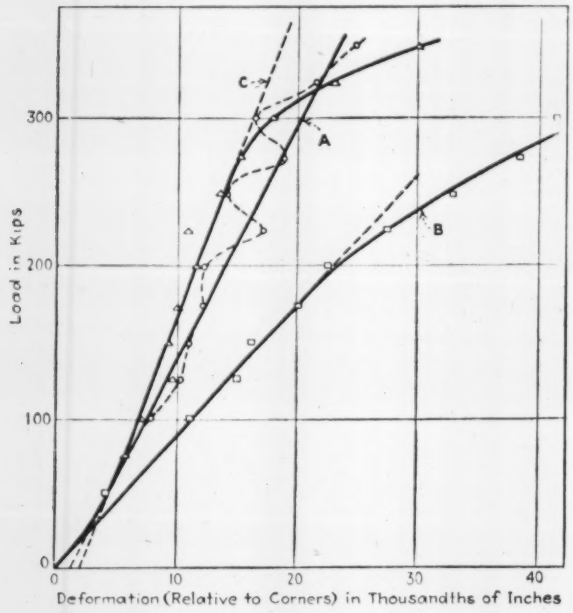


FIG. 4—LOAD DEFORMATION CURVES FOR MIDPOINTS FOR THREE STEEL SLABS
A, 18-in. square slab 1.95 in. thick; *B*, 18-in. square slab 1.45 in. thick; *C*, 13x18-in. slab 1.45 in. thick.

to the web of the column than about the principal axis. This fact, in conjunction with the noticeable scaling at the corners of the slabs indicating localized flow and with the fact that the column could be rocked slightly after relieving the load, was interpreted by Professor Merriam to mean that the load from the column approached uniform distribution.

An important byproduct of the tests was the discovery that the yield point of the slab in bending came at a load which was almost 50 per cent higher than that which would be calculated by using the tensile yield point stress in the flexure relation $s = Mc/I$. Professor Merriam stated that this results from the fact that the outer layers of steel cannot enter the plastic stage independently of the inner layers, and hence the stress distribution, although triangular up to the proportional limit, becomes nearly rectangular before plastic flow in bending actually takes place.

In devising a design method based on the results, it was reasoned that since in square slabs the bending was concentrated along the axis coinciding with the web, an economical slab would not be square, but its shape could be accurately determined by making the average bending moments per inch at the two principal axes equal. Other assumptions were that the load from the crumbling footing be taken as uniformly distributed and that the load from the column also be taken as uniformly distributed. Furthermore it was assumed that the slab reached its yield point in bending when the column reached its maximum load and the footing began to crumble. In applying the design method bending moment equations about the two principal axes of the column are equated. These equations will include the length and width of the slab, and by cut and try the most economical combination can be found. It is quite possible that the Institute will undertake to prepare tables based on this design.

Statistics and Business Methods

Two other papers bearing directly on the business side of the fabricating industry were important and unusually well received. Alexander Wall, of Robert Morris Associates, Lansdowne, Pa., made a plea for more confidential relations between fabricators and their bankers and explained how composite balance sheets and financial statements, kept up to date, provided a check on unsound and unhealthy debts and inventories.

In an address entitled "Sense for Dollars" L. Seth Schnitman, in charge of the Department of Commerce *Survey of Current Business*, emphasized the importance of statistics in modern merchandising and asked the structural steel industry to assist him to do two things: (1)

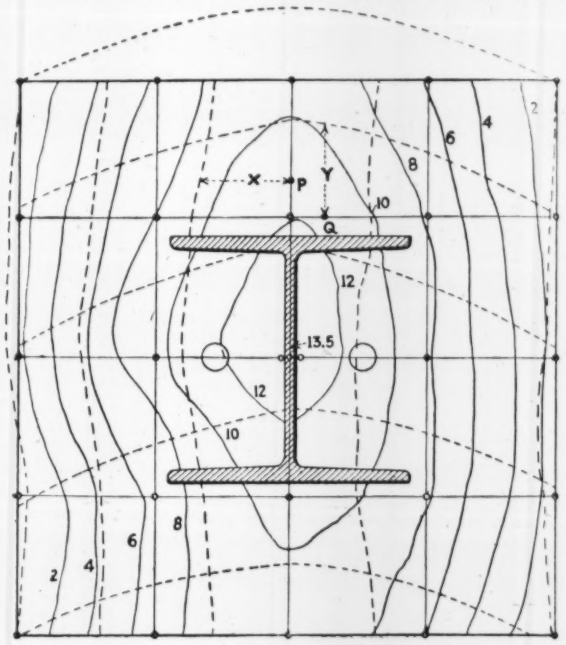


FIG. 5—CONTOUR LINES SHOW SHAPE ASSUMED BY SLAB UNDER LOAD
Contours are labeled with numbers which represent the load rates of deformation in half-thousandths of an inch per 100 kips of load. *x* and *y* are load rates of deformation for points *P* and *Q*.

break down monthly shipments and bookings data by geographic sections; and (2) segregate bookings and shipments into three different size-groups of fabricators—under 500 tons, from 500 to 2,499, and over 2,500 tons monthly capacities.

The convention was concluded by a report of the mills relations committee, H. A. Fitch, Kansas City Structural Steel Company, chairman. The financial support of the Institute's program by the mills has not increased over last year, but there is room for optimism because of the mills' growing interest in the Institute's program, according to the report. The need for more money at the present time is predicated largely on the desire and necessity for the Institute to inaugurate an extensive research program. The report mentioned such a list of subjects to be studied as fundamentals of structural design, fireproofing, types of buildings for the city of 1940 and building floors.

Basing Sewage-Works Requirements on Stream Pollution Studies

Defeat of First Proposed Bond Issue Followed by Adoption of Second and Simpler Plan After Analytic Work

By A. C. Purdy

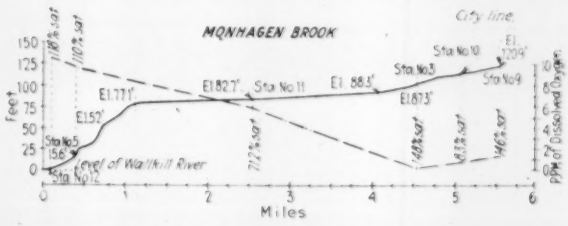
Partner in Bull & Roberts, Consulting Chemists, New York City

MUNICIPAL authorities find it difficult to overcome the inertia and frequently the antagonism of the taxpayers toward expenditures for sewage-disposal purposes. One effective means of meeting this situation is to place before the taxpayers the facts relative to their local stream-pollution problems obtained as the result of a thorough investigation by parties in no way connected with other phases of the problem. Such an investigation should establish the necessity or advisability of constructing sewage-works and the degree of treatment which such works should be designed to accomplish, when their presence is found desirable. With data thus obtained, the engineer is able to design and construct a disposal plant suited to local needs.

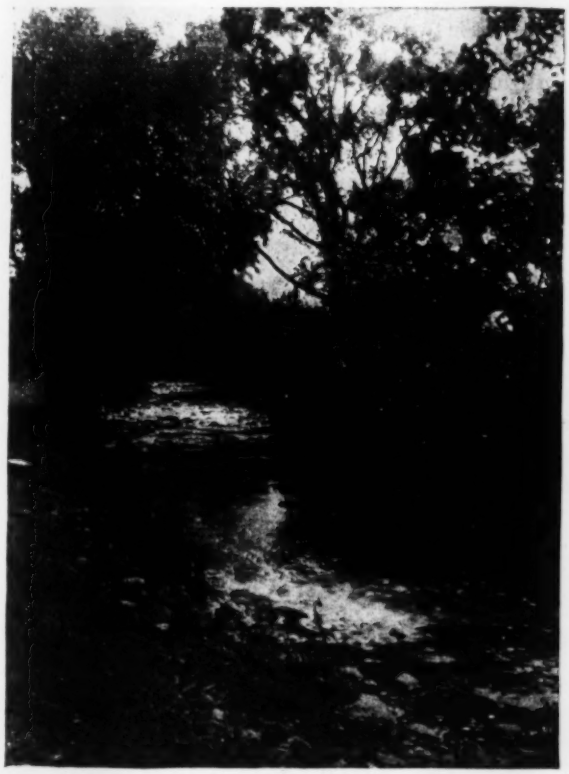
The case of the city of Middletown, N. Y., illustrates these points. Upon request of local officials, an engineering firm drew plans for a disposal plant, and a bond issue to cover the cost of construction was placed before the taxpayers. The bonds were defeated. The Common Council, appreciating that much of the opposition lay in the doubt in the minds of the people that such a plant was necessary or desirable, deemed it advantageous to have an independent investigation made to ascertain the actual facts. Such an investigation was subsequently undertaken and plans, based on the data thus obtained, were submitted by a firm of engineers, covering a plant peculiarly suited to the local problem. These plans proved to be entirely satisfactory to the state Department of Health and resulted in a saving to the city of more than $100,000, or approximately one-third the cost of the original plant proposed, at the same time providing all reasonable safeguards against creating a nuisance. When the matter was placed before the taxpayers again they authorized the bond issue necessary for the construction of the plant.

MIDDLETOWN AND MONHAGEN BROOK AND WALLKILL RIVER

In the investigation of the sewage-disposal problem of Middletown, certain facts peculiar to the local situation had to be considered. By legislative enactment in 1879, Middletown had been authorized to use a small watercourse known as Monhagen Brook for drainage and sewage, provided the city purchase such right from the riparian owners, which it subsequently did. This brook, which flows through a very sparsely inhabited countryside, enters the Wallkill River 5½ miles distant from the sewage outfall. Our investigation established the fact that the Wallkill River enters the state in a polluted condition and has been so recorded by the State of New Jersey. During its passage through the State of New York, the river is not used as a public water supply and, as far as we have knowledge, it has never been considered for such a purpose. It was, therefore, incumbent on Middletown to provide only such aid to the self-purification effected in Monhagen Brook that the rights of the riparian owners along the Wallkill be in no way violated by the creation of a nuisance.



PROFILE OF MONHAGEN BROOK AND DISSOLVED OXYGEN CURVES ON JUNE 9, 1927



LOOKING DOWN MONHAGEN BROOK FROM STATION 5

The field work of this investigation covered the period from January to October, 1927. Some 2,700 chemical and bacterial tests were made, the sampling being more frequent during the summer months. Inspections were made and sampling points established along Monhagen Brook from the point of sewage outfall to its confluence with the Wallkill River, and along the latter stream from the point where it enters the state from New Jersey to a point some 12 miles below the mouth of the brook.

The investigation clearly established the importance of the self-purification in the brook, which factor had until then been overlooked. Previous consideration of the problem had assumed that the sole natural aid to the handling of Middletown's sewage problem was by dilution in the Wallkill River. Since the average dry-weather flow of this river was said to be only some 70 sec.-ft. and it was claimed that a flow of 90 to 168

Stations	Wallkill River			Monhagen Brook	
	2 and 7	13 and 4	1	3	5 and 12
	P.P.M.	P.P.M.	P.P.M.	P.P.M.	P.P.M.
Total solids	193	180	164	276	233
Mineral solids	138	135	123	210	188
Organic and volatile solids	55	45	41	66	45
Free ammonia as nitrogen	0 18	0 32	0 22	8 7	5 4
Organic nitrogen as nitrogen	1 01	0 94	1 18	9 4	4 8
Nitrates as nitrogen	0 26	0 20	0 35	0 22	0 17
Nitrites as nitrogen	0 001	0 014	0 011	0 011	0 037
Chlorides as chlorine	6 2	7 0	7 1	38	31
Dissolved oxygen	8 4	8 4	8 8	4 3	8 5
Dissolved oxygen, per cent saturation	79	86	80	39	87
Oxygen consumed	10 7	10 9	9 2	20 5	13 5
Biological oxygen demand	none	none	none	45	2
Bacteria, colonies per c.c. (agar plates at 37 deg. C.)	1,080	10,120	1,050		266,480
B. coliper c.c.	18	56	19		11,737
Residual oxygen (summer months only)	6 5	5 9	6 9		

sec.-ft. would be necessary to prevent a nuisance if the sewage of Middletown entered it in the raw state, it had therefore been assumed that the disposal plant must be designed accordingly. By taking into account the demonstrated self-purification accomplished in the brook, it was possible to recommend a much simpler and more economical plant.

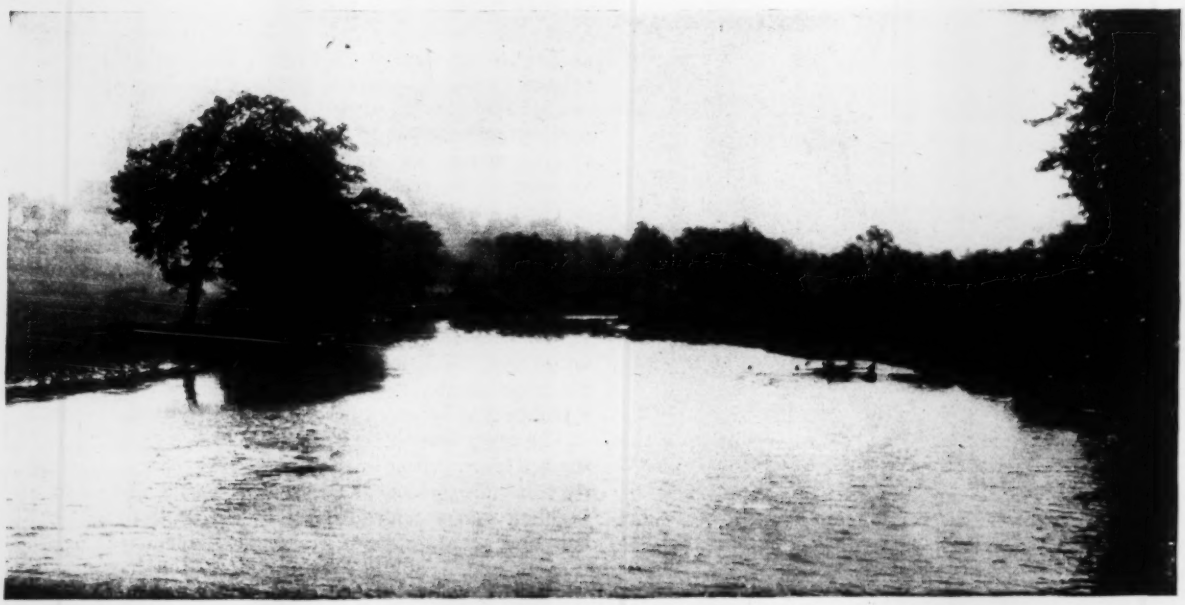
Middletown, with a population given as 20,412 in 1925, furnished a sewage made up principally of domestic wastes, together with some manufacturing wastes from such industries as a tannery, a fur factory and a gas plant. It has been estimated that the average dry-weather volume of this sewage runs about 3,500,000 gal. daily, with a wet-weather flow of perhaps double this amount.

Monhagen Brook rises in the western section of Middletown and passes through the city, where it receives the discharge from a tannery and the heavy stormwater flows of overburdened sewers. It receives the discharge of the outfall sewers at the southern end of the city, then flows rapidly along near the highway for some ¾ mile, then somewhat sluggishly through low farm land until it reaches a point about 1½ miles below sampling station 11, where it speeds up again and falls over rocky ledges to a point near station 5, where it again assumes a relatively quiescent flow to the Wallkill River about ½ mile distant.

Analyses of the samples taken at the various stations along the brook would indicate that the brook aerates and digests to a marked extent the sewage it receives and that it deposits solids and becomes clearer. Below station 3 dissolved oxygen is built up and the biological oxygen demand decreases. The term biological oxygen demand was used in this investigation to represent the amount of oxygen that must be furnished from outside sources to stabilize the organic matter in the sample. In most cases the samples examined contained material amounts of dissolved oxygen and we determined whether additional oxygen was required to stabilize the organic matter, and, if so, how much. If no additional oxygen were required, then the water could not give off odors of putrescing sewage, and this was an important point for the purpose of this investigation. We always found some biological oxygen demand at station 3, the maximum being 148 parts per million (p.p.m.). At station 5 the maximum was between 9 and 16 p.p.m. and usually there was no demand at all. The minimum dissolved oxygen observed at station 5 was 4 p.p.m. (or 46 per cent saturated). During the dry part of the summer, when conditions should have been at their worst, small amounts of green growth could be observed in the bed of the brook at station 11 (approximately the half-way point to the river), and abundant green growths covered the brook's bed at station 5, thus confirming the analytical figures as to the prevailing dissolved oxygen conditions of the water.

At no time during the investigation did conditions in the river below the mouth of the brook indicate that an excessive burden was being placed on the Wallkill River. We always found an abundance of dissolved oxygen at station 13, and no biological oxygen demand (as defined above) was ever found at this point. Determinations of residual oxygen on samples taken on the same days during the midsummer period at stations 7 and 13 indicated that the demand on the dissolved oxygen of the river between these two points did not exceed 1 p.p.m.

Averages of the analytical results obtained during the investigation indicate clearly the partial purification effected in the brook and the further purification effected in the river. The averages for stations 2 and 7 are rep-



LOOKING UP WALLKILL RIVER AT STATION 13

sentative of conditions in the Wallkill River ¾ to 1½ miles above the mouth of Monhagen Brook, while the averages for stations 4 and 13 represent conditions ¾ to 1¼ miles below the junction. Station 1 was located about 12 miles below the mouth of the brook.

Although the investigation clearly indicated that the purification effected in the brook was sufficient to handle the sewage of the city during times of flush or normal flow, it was felt advisable to provide protection against periods of hot dry weather. For this purpose a disposal plant consisting of a sedimentation tank with separate sludge digestion was recommended. It was believed that such a system, by removal of the more readily settling solids, would prevent the formation of sludge banks in the brook. During protracted periods of hot dry weather these banks might cause excessive loads to be placed on the brook at a time when its powers of purification would already be taxed by the current flow of sewage.

Concrete Arch of Unusual Design Aids Highway Relocation

Wide Arch Ribs Eccentrically Loaded Used to Support Spandrel Columns on Curve—Superelevation of 2 Ft.

By D. M. McPhetres
Bridge Engineer,
Santa Cruz County, Calif.

A CONCRETE arch bridge of open spandrel type in which the columns have a curved alignment and are supported on wide arch ribs was recently made use of to eliminate a dangerous traffic condition in Santa Cruz County, Calif., where the location of the county highway required a sharp right-angle turn under a railroad track at the end of the old bridge across Aptos Creek. Any relocation was fixed at one end by the position of a small town and, near the bridge site, by the need of maintaining the existing railroad underpass. The new alignment adopted included the curved bridge, 1,200 ft. of new location and replacing of the two-span underpass with a single 75-ft. railway span because of the narrower angle of intersection as shown by the accompanying drawing.

The new bridge, curved to a center-line radius of 400 ft., is 326 ft. long with a main span consisting of a 123-ft. two-ribbed spandrel arch. The pairs of spandrel columns are spaced at 15-ft. centers along the curve, and this same spacing is continued in the approach spans at either end. The deck is composed of a 24-ft. roadway with a superelevation of 2 ft. and two 4½-ft. sidewalks on 10-in. curbs. The height of the roadway is 72 ft. above streambed and the arch has a clear rise of 38 ft. 6 in.

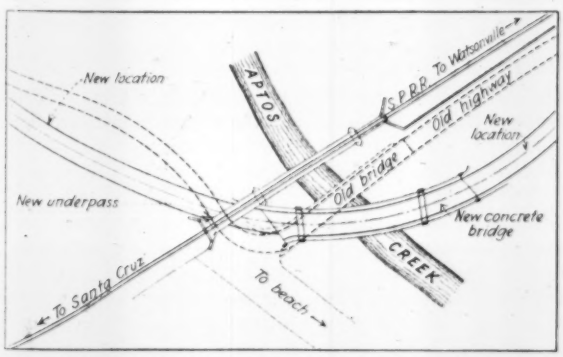


FIG. 1—PLAN OF HIGHWAY RELOCATION

FIG. 2—WIDE ARCH RIBS FOR COLUMNS ON CURVE
Note uniform deck overhang secured by allowing eccentric loads on ribs.

The arch ribs, 23 ft. 9 in. center to center, are 2½ ft. deep at the crown and 7 ft. wide to provide for the curved alignment of the superstructure columns. The two-column bents on the arch and in the approaches are all parallel and are at right angles to the center line between the arch ribs. The outside faces of all columns, however, are parallel to and 13 ft. from the roadway center-line curve. This design feature was adopted, instead of a structure with columns in a straight line and sidewalk brackets of variable length, because of the better appearance of uniform overhang and the additional advantage of simplified deck formwork, although the rib section was required to be increased over the actual stress requirements.

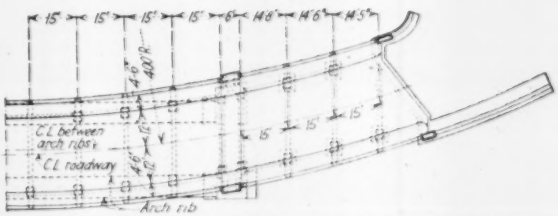


FIG. 3—PLAN OF COLUMNS ON WIDE ARCH RIBS OF BRIDGE, SHOWING CURVED ALIGNMENT

There are six vertical joints in the deck: two construction joints at the third points over the arch and four expansion joints, provided with sliding bronze bearing plates and a ¾-in. joint filler through roadway and sidewalk at both sides of the arch abutments. The roadway surface at the expansion joint corners is protected by angle iron, and all joints in the railing are left open ¼ in. by inserting steel plates in the form and removing them when the concrete has set. Arch ribs were poured in five sections separated by 2½-ft. key sections which were concreted 48 hours later. Although an inch of settlement was provided for in the timber falsework of the arch, only ⅜ in. occurred during concreting and no appreciable

deflection could be observed after the centers were struck.

Work was done by Santa Cruz County, under the direction of Lloyd Bowman, county engineer. Design and supervision of construction were in charge of the writer. The general contract for the bridge was held by Thompson Bros., of Santa Cruz, Calif., with N. M. Thies in charge of the work for the contractor. The contract cost of the bridge, exclusive of earthwork approaches, was $40,716.74.

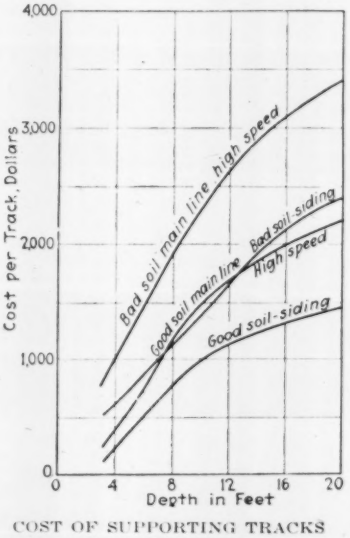
Pipe Tunnels for Water Mains Under Railroad Tracks

Pipe in Tunnel Generally Preferable to Pipe Buried in Trench—Cost of Supporting Tracks—Practice at Detroit

IN LAYING water mains under railroad tracks, a tunnel in which the pipe is permanently accessible for inspection and repair is generally more satisfactory, and may often be cheaper, than placing the pipes in an open trench, which is then backfilled. This was the theme of a paper read at the recent Detroit meeting of the Central States Section of the American Water Works Association by L. G. Lenhardt, assistant engineer of land tunnels in the department of water supply, Detroit, Mich.

For trenches in good soil and not exceeding 2½ ft. in width and 6 ft. in depth, the cost of carrying a track with rail supports is given as about $25, but for large trenches in poor soil and crossing high-speed main lines the cost increases rapidly. Curves for cost of trenches 7 ft. wide and 4 to 20 ft. deep, with pile trestles to carry the tracks, have been prepared by J. E. Bebb, assistant bridge engineer of the Michigan Central Railroad, and are shown in the accompanying drawing, which accompanied the paper. Where a heavy-traffic main line or a busy yard has to be crossed, the question is one of expediency rather than cost, as railroads dislike to have such lines disturbed, especially if a wide trench is required. Furthermore, a pipe buried under railway tracks is difficult to repair, and some of the load of passing trains may be transmitted to the pipe and eventually cause a break or open joint. As to the practice at Detroit, the following is an abstract of the paper:

A pipe tunnel should be large enough to allow the pipe to be placed and calked or riveted and to be repaired with reasonable facility. For a cast-iron main, this usually means putting in a length of replacement pipe. In the larger steel mains, repaired by welding or riveting, not so much room is necessary. Usually the smallest vertical dimension is 5 ft., in order to give headroom for the workmen. At a shaft, beveling its intersection with the tunnel roof will allow the pipe to be entered with greater facility and may make possible saving in the size of the tunnel.



COST OF SUPPORTING TRACKS OVER TRENCHES

For installing water pipes, sewers and conduits. The estimates are based on trenches 7 ft. wide, with pile trestles to carry the tracks.

In the Detroit tunnels the minimum clearance is 8 in. for cast iron and 12 in. for steel pipe. For access to the bottom of the pipe, it is carried above the tunnel floor by supports, which should be of a permanent nature. Channels, I-beams or pairs of angles embedded in the concrete are the usual practice. Pillow blocks of creosoted wood on these supports are anchored to prevent sliding with the expansion or contraction of the pipe. To facilitate drainage, the tunnel should be on a grade, preferably to one end so that only one sump and pumping unit is necessary. Seepage should be guarded against, as water leaking through the masonry may carry alkaline salts destructive to pipe coatings. In wet ground it is well to force grout behind the masonry until the water is cut off. Where this is not done, sheet-metal pans should be placed over the pipe.

With cast-iron pipe of moderate size and length a calked lead joint will probably provide for expansion and contraction movement, but riveted or welded steel mains require regular expansion joints. If two or more expansion joints are used, the pipe should be anchored midway between joints so as to insure both joints operating. In the Mount Elliott pipe tunnel, Detroit, with 2,000 ft. of 48-in. bumped-joint hammer-welded steel pipe, two expansion joints are provided, with a concrete pier cast about the pipe midway between them. Slightly more than 1 in. expansion has been observed in each joint. In the Central Ave. tunnel, with 1,400 ft. of 60-in. steel pipe, two expansion joints will be provided, with anchorage midway between. In the Dix Ave. tunnel, with 417 ft. of 36-in. steel pipe having Matheson joints, no expansion joints are provided, but each joint will be held in place by a steel band fastened around the spigot end of the pipe and butting up tightly against the lead to prevent its working loose.

Walkways through the tunnel may consist of one or two planks on one or both sides of the pipe, preferably creosoted and fastened to the pipe supports. Electric lights and moisture-proof cables should be specified, with cables heavy enough to allow power outlets for construction and maintenance work. Hangers embedded in the masonry over the joints add considerably to the facility with which pipe can be placed or repaired. With large and heavy pipe, a monorail beam fastened in the crown simplifies the handling and laying problem, the masonry lining being designed to take care of this load. The thickness of lining depends on many factors, but generally the following thicknesses for circular tunnels will be approved by the railroads: (1) up to 6 ft. diameter, 10-in. concrete or three rings of brick; (2) 6 to 9 ft. diameter, 14-in. concrete or four rings; (3) 9 to 12 ft. diameter, 18-in. concrete or five rings of brick.

Powdered Admixtures in Concrete

Two series of concrete tests reported upon at the last meeting of the American Society for Testing Materials by Duff A. Abrams, director of research for the International Cement Corporation, produced interesting results with regard to the effect of powdered admixtures on strength and workability. Seven commercial and seven non-commercial admixtures were used in percentages ranging from 2 to 15 per cent of cement. Those admixtures which were slightly hydraulic showed only a small increase in strength, whereas the non-hydraulic admixtures showed reduction in strength up to about 5 per cent for each 1 per cent of admixture in terms of weight of cement. Colloidal clays and diatomaceous earth gave the greatest reduction in strength. In general, the reduction in concrete strength was greater at one, two and three days than at seven days to three months. None of the admixtures improved the workability as measured by the flow test. Other conclusions given by Mr. Abrams are as follows: (1) The water factor (defined as a quantity of mixing water required by the addition of a unit weight of any constituent in order to maintain a given workability) required to produce the same workability as similar concrete without admixture was approximately proportional to the normal consistency of the admixture as measured by the Vicata needle; (2) all of the commercial admixtures tested must be classed as injurious adulterants, because of their high water factors; (3) the effect of admixtures was independent of the quantity of admixtures used, although quantities higher than 15 per cent were not considered.

Criticisms of Bonnet Carré Spillway

Two Discussions by Prominent Engineers Question Adopted Location and Weir Design—Saving of $10,000,000 Claimed for Upstream Location

PUBLICATION of the designs for the great Mississippi River spillway at Bonnet Carré, just above New Orleans, in *Engineering News-Record* of Aug. 15 has aroused vigorous criticism. Two specific criticisms are here set before the engineering profession. Prof. W. B. Gregory, of Tulane University, who had a leading part in the experimental studies on which the design is presumably based, charges that the plans depart seriosuly from the test findings and that they contain important inconsistencies. A. B. B. Harris, consulting engineer, formerly with the Illinois Central Railroad, attacks the location as faulty and wasteful and outlines reasons for his belief that $10,000,000 or more can be saved by more thoroughly studied design.

So great a hydraulic structure, vital to the security of New Orleans and immediately adjacent regions, is clearly a matter of prime engineering concern. The discussions are published in the interests of full and broad professional consideration of the problem at issue. —EDITOR.

Hydraulic Experiments at the Bonnet Carré Spillway

BY W. B. GREGORY
Consulting Engineer, New Orleans, La.

THE hydraulic experiments at the Bonnet Carré spillway have been briefly described by W. W. De Berard in *Engineering News-Record* for Aug. 15, 1929, p. 242. The field work was carried on by I. A. Winter, of the Alabama Power Company. The writer was consulting engineer in the hydraulic tests made at Bonnet Carré and from the experiments deduced some conclusions regarding the best design for spillway structure.

As the experiments made with a model one-sixth size were checked by the one-twentieth size model in essential points, they were quite conclusive and satisfactory. Velocities beyond the apron that might cause scour were determined by means of Pitot tubes. These instruments were found to be most reliable and the coincidence of the results, when stepped up to the full-sized structure by means of the law of similitude, was remarkable.

The experiments showed the superiority of a vertical weir over the ogee type and showed conclusively that a weir at El. 18.5 would discharge the required amount of water when the level in the river at the spillway is at 24 and the Carrollton gage at El. 20. The design that appealed to the writer was one with steel gates extending from El. 18.5 to El. 25, the entire length of the spillway. The length of each gate that was first proposed was 20 ft. between piers, but later it was found that a length of 30 ft. was permissible and that each gate could be handled in a satisfactory way by means of a locomotive crane, running on a track above the piers. The change in length from 20 to 30 ft. of course reduced the cost of the structure considerably. To meet future and unknown conditions another set of gates could be used extending from El. 14 or El. 16 up to the steel gates at El. 18.5. The lower gates could be made of concrete, at least for a part of the length, to be so constructed that they could easily be removed and replaced by steel gates at some future time when such a change was found desirable.

The design that was finally selected is to have one-half the length of the spillway sills at El. 16 and one-half at El. 18. Now, the stilling basin and baffle design was worked out for the sills at El. 18.5. The tests showed that, with the entire length of spillway sills at El. 18.5, the normal discharge would take place and that there was no danger from scour if the spillway were put into action with no backwater in the floodway and with water in the river at its maximum allowable height. This is not the case for that portion of the spillway with sill at El. 16, because of the large increase of velocity due to the increase of head. Here it will be necessary to leave a part of the needles in place or to wait until the discharge has built up a backwater before the needles may be removed and the maximum opening had. This method of handling the spillway with needles and with sills at two different levels seems to the writer to be very crude and very slow as compared with a structure having steel gates as described above.

Two considerations made the choice of steel gates seem highly desirable. They could be quickly opened when necessity required and could be quickly closed. Furthermore, such gates were designed to be practically watertight, preventing leakage when the spillway was not in use.

The desirability of quick opening of gates will possibly not be so great as that for sudden closing in case of any disaster to the side levees of the floodway. Of course, it may be argued that these levees will be so well constructed that a failure is impossible, but it must be admitted that these levees are built of available material which is not of ideal quality and on soil that is soft and somewhat treacherous. Between the spillway and New Orleans are the parishes of St. Charles and Jefferson, with a rapidly increasing suburban area that is above the protection levee of Orleans Parish. Levees have been used for more than 200 years along the Mississippi, and during every great flood many have failed. Aside from the consideration of levees, it is within the range of possibilities that other conditions will arise, such as a washout of a railroad bridge, that will demand a sudden closing of the spillway, and the writer believes that gates can be handled more quickly and effectively than needles.

The problem of leakage has been referred to above. In the article by Mr. De Berard the statement is made that normal discharge through the Bonnet Carré spillway will carry about 400,000 tons of solids per day. It is to be hoped that the greater part of this material will be carried through the floodway and be deposited in Lake Pontchartrain. It has been estimated that 10 to 15 per cent of this material will remain in the floodway, but exactly what will happen, of course, is not known, as it will largely depend on conditions that are maintained in the floodway.

Leakage through needles is worthy of consideration. With sills half at El. 16 and half at El. 18 for a total

length of about 7,000 ft., it is evident that there will be considerable leakage whenever the water at the weir is above El. 16, especially after the needles acquire some age and are warped by exposure to a subtropical sun. The water that leaks through will carry an appreciable amount of silt, and because of the relatively low velocities these solids will practically all be deposited in the floodway. In the course of years this may become a serious problem.

It is the opinion of the writer that the gate dam is vastly superior to the needle dam from every point of view and the sills ought to be at a common level for the entire length of the spillway.

* * *

Bonnet Carré Spillway Believed to Be at Wrong Location

By A. B. B. Harris
Consulting Engineer, Chicago

IN THE judgment of the writer, a monumental engineering and economic mistake will be made both as to location and as to design if the proposed Bonnet Carré spillway is located and constructed as outlined in *Engineering News-Record* of Aug. 15, 1929, p. 242.

Location—The accompanying maps show the location of the proposed spillway and its necessary guard levees as given in Mr. De Berard's article, and also an alternative location for the spillway and guard levees. The advantages of this second location are as follows:

(a) Less likelihood of trouble from caving banks.

(b) The diverted water will have a higher initial velocity, due to direct flow into the floodway without change of direction.

(c) A fall from the river to the lake greater by 1 ft. or more on account of the proposed spillway being 5 miles farther upstream.

(d) The floodway will be 6,000 ft. shorter.

(e) The combination of shorter distance, greater fall and higher weir velocity makes it practical to have a much narrower spillway at this location, which will greatly reduce the construction cost and materially lessen the cost of maintenance and operation.

(f) This proposed location admits of a combination spillway and bridge for an important highway and two railroads which will greatly reduce the construction, operating and maintenance costs. The wider the spillway the greater the saving.

(g) There will be 10,000 ft. less marsh to cross with the guard levees, which will greatly reduce their construction cost.

(h) As the location is 5 miles farther upstream, it will materially lessen the levee requirements for 5 miles on both sides of the Mississippi River.

The foregoing points indicate conclusively that the upstream location should be adopted. In this connection it may be said that this is the location selected by Charles Ellet, Jr., as set forth in his masterly work on the Mississippi and Ohio rivers, published in 1853, and which, by act of Congress, was re-issued in part last year (1928).

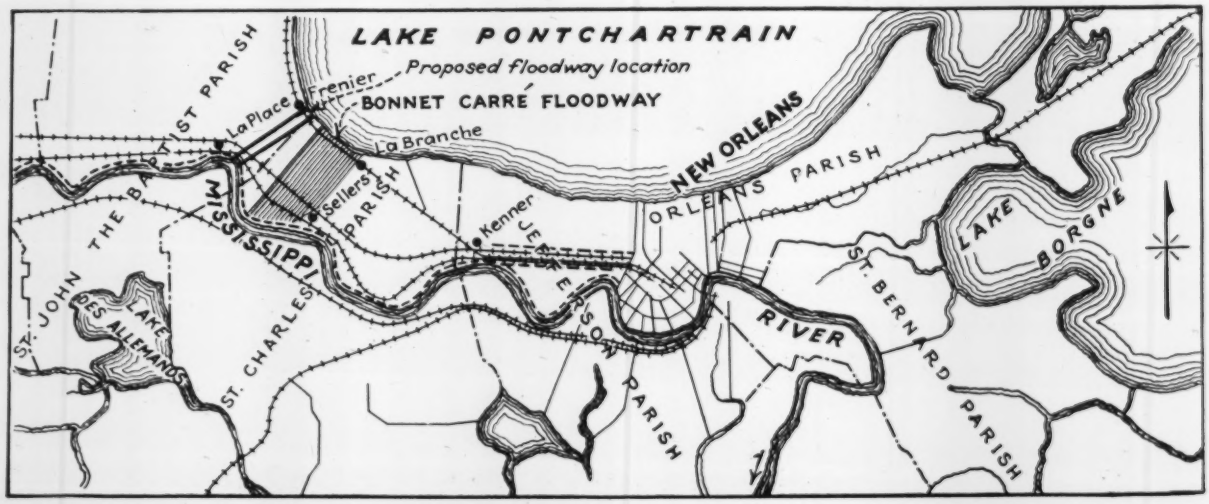
Design—Since it is necessary to bridge this spillway for two important highways, two single-track railroads and one double-track railroad, and place an 18-in. high-pressure gas main under it, economy of construction cost, operation and maintenance demands that it be made as narrow as is consistent with effective flood control and safe railroad and highway operation. The minimum safe weir length depends on three factors: depth of flow over the weir, mean weir velocity and the maximum discharge required.

From a study of the profile, which is along the center line of the proposed upstream spillway, in my opinion the economic depth of flow over the weir is about 18 ft. It will also be seen from the profile that the slope (head 23.3 ft., distance 26,000 ft.) is 0.0009, or 4.75 ft. per mile. Applying these values to Ellet's formula $V = 0.8\ (S \times H)^{\frac{1}{2}} + \frac{S \times H}{20}$ (which was compiled for this particular purpose by Mr. Ellet after years of careful investigation), we have 11.66 ft. per second. This velocity with a depth of 18 ft. and a net weir length of 1,440 ft. (eighteen 80-ft. clear spans) gives a discharge capacity of 302,220 sec.-ft., which is 52,220 sec.-ft. more than the maximum required.

Applying these dimensions to Kutter's formula $V = C(RS)^{\frac{1}{2}}$ and using a coefficient $C = 160$ (see Trautwine's tables) we have $V = 160\ (12.41 \times 0.0009)^{\frac{1}{2}} = 16.8$ ft. per second. This weir velocity of 16.8 gives a discharge capacity of 435,456 sec.-ft. Using Kutter's formula with a coefficient of 110 gives a flow velocity of 11.55 ft. per second, practically the same velocity as given by Mr. Ellet's formula.

It is well to note in this connection that at points in New Orleans, 31 miles below this proposed spillway, the Mississippi River at high water is not more than 2,000 ft. wide.

If this upstream location is adopted, economy will result from building at the upper end a combination weir, highway and double-track railroad bridge (one track for the Y. & M. V. R.R. and the other for the L. R. & N. R.R., and at the lower end a combination weir, high-



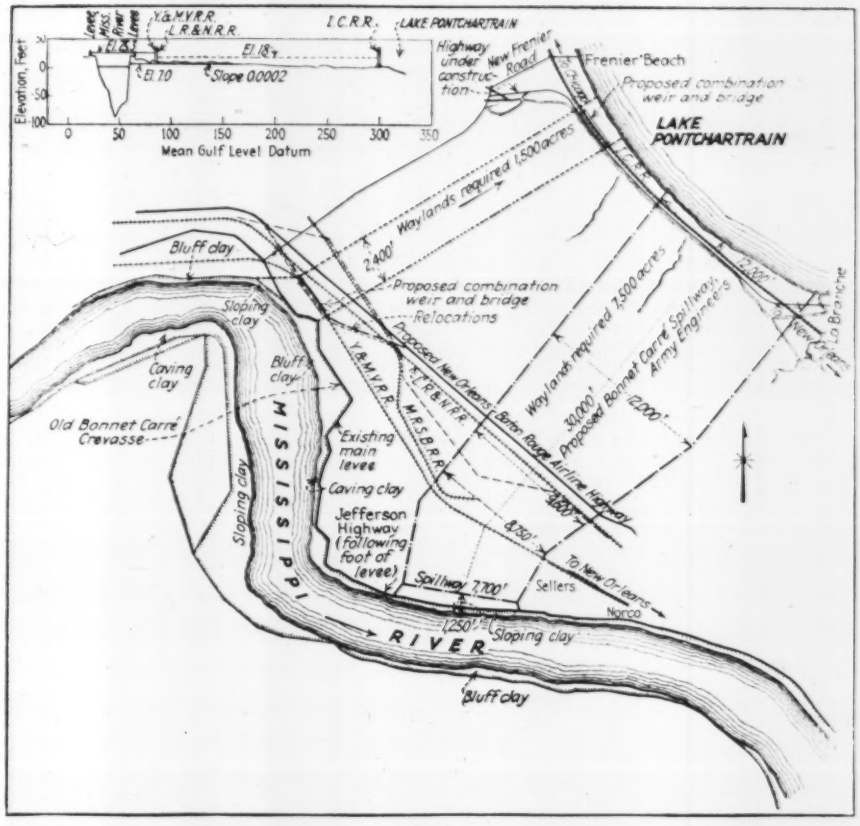
LOCATION OF BONNET CARRÉ SPILLWAY IN RELATION TO NEW ORLEANS

way and double-track railroad bridge for the I. C. R.R. These structures will necessitate realignment of the highways and railroads as shown on the map.

The open floodway of this narrow spillway should be about 1,600 ft. in width. Between this open floodway and the guard levees there should be strips of growing timber or brush not less than 300 ft. in width, to protect the guard levees from scour and wave wash.

To hold the New Orleans gage at approximately 20 ft. during high water, there is proposed a combination spillway and bridge, equipped with a double set of water-control gates. This plan contemplates constructing the combination spillway and bridge of 85-ft. girders (through or deck), giving about 80 ft. clear span between the piers, which will prevent any trouble from drift.

As I understand it, the only reason for making the proposed Bonnet Carré spillway broad and shallow instead of deep and narrow is the fear of excessive erosion. If an adequate depth is maintained in the floodway of the deep, narrow spillway while in active operation, the erosion will not be excessive and may be less than in the broad, shallow spillway now contemplated. This adequate depth of water can be maintained by placing at each end of the floodway a combination weir and bridge and equipping both with water-control gates.



PLAN AND PROFILE OF PROPOSED BONNET CARRÉ SPILLWAY

In normal position the upstream gates are closed and the downstream ones open. Just prior to putting the spillway into active operation the downstream gates are closed and enough water is allowed to flow into and gradually fill the floodway to the top of the downstream gates at El. 18. Ample time will be available to do this preliminary flooding of the floodway, as the stages of the water in the Mississippi River above this point will fix definitely, several days in advance, the time when the spillway will have to be put into active operation. With the proper adjustment of the control gates, a sufficient depth and flow velocity can be maintained in the floodway to minimize both erosion and silting. The high-flow velocity will be dissipated in Lake Pontchartrain, where it will do no harm but, on the contrary, will prove useful in distributing the silt over a large area and thus lessen the dredging necessary to keep the floodway open.

Cost—The total cost of constructing the narrow spillway (as outlined above) with its necessary waylands (1,500 acres), guard levees, bridges, etc., will be but little if any more than one-third the cost of constructing the broad spillway with its necessary waylands of 7,500 acres. The saving in construction cost will be not less than $10,000,000. In addition to this large saving in construction cost, the cost of operation and maintenance will also be greatly reduced.

As this spillway will be in active operation on an average only about 30 days every third year and working at full capacity but a few days at intervals of from ten to twelve years, the damage if any resulting from the increased flow velocity will be insignificant as compared with the resultant saving in the cost of maintenance and operation. In the construction of this short, narrow spillway about 4,000,000 cu.yd. of embankment material will be required for the guard levees and bridge approaches. This material, as far as practicable, should be taken from the floodway. In this connection a thorough investigation should be made as to the advisability of making a lake (estuary to Lake Pontchartrain) of a large portion of the floodway. This might not prove expensive, as the dredged material could be deposited behind the guard levees and thereby convert swamplands into valuable property.

Large Pumps for London Water Supply

The installation of two very large triple-expansion pumping engines in the Kempton Park pumping station in England has been the occasion for enthusiastic comments by the editors of *The Engineer* (London). Each of these engines is rated at 1,000 hp. and has an over-all height of 62 ft. from the base of the pumps to the top of the valve bonnets. An interesting feature in the design is the use of compound plungers in the water end of the pumps. These really consist of two plungers, one concentric with the other, and make possible the delivery of (*a*) 24,000,000 gal. daily against a head of 400 ft., (*b*) 32,000,000 gal. daily against 300 ft., (*c*) 38,000,000 gal. daily against 200 ft., with the horsepower exerted by the engine remaining approximately the same.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Hardships by Request

DOWN THE WORLD'S MOST DANGEROUS RIVER—By Clyde Eddy. New York: Frederick A. Stokes Co. Cloth; 6x9 in.; pp. 293; 18 halftones. $2.50.

Adventure for its own sake, without hope or expectation of monetary reward, is becoming rare in this somewhat mercenary world; a fact which lends additional interest to this account of an 800-mile trip down the most hazardous section of the Colorado River. That the thirteen men in this party took their lives in their hands is undeniable, for the history of this stream is marked by many accounts of disaster. Mr. Eddy, who made an intensive search for data on previous expeditions as part of his preparation, states that "fewer than 50 men in the history of the world ever had made the voyage through from Greenriver, Utah, to Needles, Calif.," and that at least that number had died in vain attempts.

Coronado is credited with the discovery of the Colorado in 1540, but the first real attempt at systematic exploration was not made until 1869, when John Wesley Powell made the first of his two trips down the river. Although his main party came through unscathed, three of his men who attempted to find their way out of the canyon were captured and killed by Indians. The next recorded expedition was conducted by Robert B. Stanton, who in 1889-90 made a survey for a projected railway through a portion of the Grand Canyon which is recounted in the *Transactions* of Am. Soc. C. E., Vol. 26, p. 283, and also in *Engineering News*, Oct. 18 and 25, 1890. From this time until 1911, when the Kolb brothers successfully negotiated the Grand Canyon, there are records of nine expeditions being lost, and in the interval between 1911 and 1927, when the Eddy trip was made, twelve more were destroyed or abandoned and one, the U. S. G. S. expedition of 1923 led by Colonel Birdseye (see *Engineering News-Record*, Nov. 15, 1923, p. 808), was successful.

This discouraging record gives some idea of the dangerous nature of the Colorado River, which drops 2,225 ft. in the 278 miles below Lee's Ferry, Ariz. Current velocities are estimated by Eddy to be as much as 30 miles per hour. The dangers incident to the negotiation of 300 rapids, together with attendant whirlpools, boulders and other obstructions, is augmented by the flashy nature of the stream. Sudden floods are not unusual, the river sometimes rising at the rate of 4 or 5 ft. an hour. The Birdseye party was flooded out of its camp one night by a rise which totaled 21 ft., and Eddy noted driftwood lodged 100 ft. above the normal level of the stream. As a final hazard, the river flows through a series of deep canyons, the walls at times being a mile in height. So sheer is the rock that escape from the bottom of the canyon is impossible except at a very few points, and the loss of a party's boats could easily mean the imprisonment of every member.

Mr. Eddy tells the story of the trip in a style which differs from the idealistic method customary in tales of adventure, in which difficulties and hardships are glossed over or ignored. Undoubtedly this is due to the fact that the book, as published, follows closely the daily journal which he kept during the journey and which, as he points out in his foreword, reflects the mental and physical stress under which the words were written. This method does not add to the reader's comfort, for it transmits to him too vividly the hardships and perils undergone. It does, however, give a greater feeling of actual partnership in the venture, and a glimpse of the fact that such pioneering exploits are far more enjoyable in retrospect than in the actual performance.

The Crisis in Utility Regulation

ELECTRICAL UTILITIES: The Crisis in Public Control—By William E. Mosher, editor; Finla G. Crawford, Ralph E. Himstead, Maurice R. Scharff, A. Blair Knapp, Richard L. Schank, and Louis Mitchell. Under the auspices of School of Citizenship and Public Affairs, Syracuse University. New York and London: Harper & Bros. Cloth; 6x9 in.; pp. 335. $4.

We stand at the parting of the ways in the electrical industry. One road leads to government regulation in the public interests and the other to a minimum of regulation in the interests of the controlling shareholders. Public indifference to the present program of exploitation which is fostered by the utility holding companies may carry us so far along the latter road as to precipitate government operation. That, in brief, is the conclusion reached in this lucid exposition of the factors affecting public regulation of electrical utilities. The authors do not accuse those in charge of framing the policies of our public utilities with flagrant dishonesty or actual misdeeds, but with failure to square with present-day ideals as to the position and function of public utilities.

The book is one of a series of studies of social problems prepared under the auspices of the School of Citizenship and Public Affairs of Syracuse University. It is divided into two parts, the first a summary of present conditions, and the second a review of the principal means of rectifying the faults which now exist.

In the first part, the reasons why most of the public utility commissions of the country are unable to exercise adequate control over electrical utilities are outlined at length. Also, the role of courts in regulation is fully stated. In respect to the latter, the authors stressed one point upon which they placed great weight—namely, that many utility commission decisions and some lower court decisions in utility cases are based on dicta of a higher court, not upon its decision. As a result many commission and lower court rulings are founded upon the higher court's comment on the case, not upon what it actually decided in the case. Many of the ills of our present system, the authors believe, are the result of this practice.

The authors favor the prudent investment theory for the determination of the value of utilities and hold up Massachusetts as an example of what can be done in the application of that theory. Apparently they do not favor government ownership and operation, but they see no inherent reason why it should not succeed here as it has in Ontario. Alternatives to complete government ownership and operation of electrical utilities are suggested in (*a*) control through state contracts, (*b*)

through public competition by the operation of larger plants like Boulder dam, *(c)* by a league of municipalities, and *(d)* by a national planning commission.

The essence of the book is a plea to the electrical utilities to clean house, to stop resisting regulation, to abandon propaganda and the manipulation of their financial set-up for the benefit of a few rather than for the general benefit of the public from which the utility companies receive the right to operate.

Effect of River Regulation on Power

BARRAGES CONJUGUES ET BASSINS DE COMPENSATION—Par Georges Laporte, Ancien Elève de l'École polytechnique, Director de l'Union Hydro-électrique. Paris: Dunod, 92, Rue Bonaparte. Paper; 6¼x10 in.; pp. 116; line cuts. In France, 32.85 fr., foreign countries, postpaid, 35.50 fr.

The study described in this pamphlet was undertaken as a preliminary to construction of the Eguzon plant on the Creuse River in France in order to determine the effect of its reservoir upon the other power plants on the river. Mass diagrams and other graphical methods of studying the effect of compensating reservoirs upon the regimen of a river were used. Various assumptions were made as to reservoir capacities in order to obtain the most desirable arrangements. The influence of the form of the riverbed upon size of the storage reservoir also was studied, and a graphical method was developed for showing the amount of energy stored at various levels of the compensating reservoir.

Steam-Power Generating Apparatus

REVIEWED BY C. HAROLD BERRY
Professor of Mechanical Engineering, Harvard Engineering School, Cambridge, Mass.

STEAM AND GAS ENGINEERING: A Text Covering Power Generating Apparatus Utilizing Energy Released by the Combustion of Fuels—By Thomas E. Butterfield, M.E., C.E., Professor of Heat Power Engineering at Lehigh University, M.A.S.M.E., New York: D. Van Nostrand Co.: Cloth; 6x9 in.; pp. 481; 335 line cuts and halftones. $4.50.

Most of this volume is devoted to descriptions of machines and auxiliaries. Some of the descriptions are much more detailed and effective than others, and a few are decidedly scanty. Now and then the apparatus covered seems somewhat obsolete, but on the whole the material is good, and covers equipment that the young engineer is likely to find in plants both old and new, small and large. The classification of apparatus is not always what one might expect—for example, condensers and vacuum pumps are classed with boiler auxiliaries.

In the discussion of the operation of various devices there is an occasional assumption of knowledge presented later in the book, but it would be difficult to avoid this in a book built on the author's plan, which has its merits.

Interspersed with descriptive matter there are some half-dozen chapters on thermodynamic theory, covered in much the way that was common twenty or thirty years ago. One finds such terms as "total heat of formation." In introducing the entropy concept, the author has avoided the faults so often evident in elementary texts by simply defining the quantity and making no attempt to discuss its nature. A purely mathematical concept had best be presented in a purely mathematical sense, or else defined and taken on faith, as in this book. Perhaps the author has gone too far in reducing his explanation to its barest elements, but that is preferable to a verbose body of error.

An excellent feature of the book is the inclusion of numerous examples worked out fully by simple arithmetic. The presentation of algebraic formulations is reduced to a minimum, and often follows the development of the numerical solution.

The general style of writing seems choppy, but often clearness and conciseness are enhanced by this departure from the canons of good writing. The book is well and profusely illustrated. The 13-p. index should be useful in study and reference. The symbols used by the author are in some instances not those most commonly used, and do not agree with the list that is in course of adoption as a standard of the A.S.A.

Some readers will object to the great space given to purely descriptive matter, some will object to the disjoined treatment of thermodynamic theory; others will find virtue in both of these features. As a text, the book should be useful in schools where slight stress is laid on theoretical rigor. For the young engineer who wishes to break into the power field without previous preparation, the book should be helpful. For the engineer with experience in the field and with a fair grasp of thermodynamics, the book seems to have little to offer.

Rails as Empire Builders

THE ROMANCE OF THE RAILS—By Agnes C. Laut. Two Volumes. New York: Robert M. McBride & Co. Cloth: 6x9 in.; pp. 589 in two volume; illustrated. $7.50 net.

Railroads are just railroads to many people, facilities for travel or shipment of freight. That they have played a major part in the history of this country does not occur to them. To such people the reading of these two volumes by Agnes C. Laut are recommended. Others who know something of the general history of our railroads also will find them informative as well as pleasant reading.

Obviously, the whole history of our railroads cannot be condensed into two ordinary-sized volumes—the history of the Baltimore & Ohio alone occupies two larger volumes—but the author has been eminently successful in picking out the high spots in railroad history. Better still, she has delved deeply enough into contemporary history to be able to give either the background of the major events in railway history which she pictures or the effect of the event itself upon history.

Personalities play a large part in the record; Harriman, Hill and others well known in the past are centers around which much of the latter part of the record moves.

The two volumes have been prepared for general reading rather than as a historical record, yet despite this a surprisingly large amount of factual matter is contained in them. Inaccuracies there doubtless are, but they are unimportant. The author's aim was to present a record of an important element in human progress in a readable way. That she has done well.

Technical Writing for Engineering Students

EXPOSITORY DESCRIPTIONS: A Textbook for Courses in Technical Writing—By Victor Solberg, Associate Professor of English, Oklahoma Agricultural and Mechanical College. New York: The Ronald Press Co., 7½x5 in., pp. 277; a few line cuts. $2.

Of late quite a few books have come to the reviewer's desk on the subject of improvement of the English in the writings of engineers. It indicates that there is a growing feeling that an engineer should have more than a knowledge of his art; he should know how to present

that knowledge in a concise, orderly and convincing manner. This book was written for use in schools and colleges. The author says in his preface: "A type of writing for which engineers and other persons engaged in technical, scientific and industrial pursuits are continually called upon is the description of appliances, machines and processes of buildings and of localities, for the purpose of giving definite information. . . . The course outlined in this book is intended to train the student preparing for technical or scientific activities in this form of necessary writing." Numerous examples of good and bad writing are given and problems are set for the student to give him practice.

Time-Saving in Arithmetic

HIGHER ARITHMETIC: Designed for the Use of High Schools and Colleges and for Self-Instruction—By Frederick A. Smith, C.E., M.W.Soc.E. Chicago: The Author, 608 South Dearborn St. Cloth; 5x8 in.; pp. 137. $2.

Despite the emphasis of our colleges on higher mathematics, the fact remains that the great mass of figure work done by the ordinary engineer and draftsman falls under the head of common arithmetic learned in grammar or high school. Those who, when confronted by such problems, find that their knowledge is hazy from lack of use will find this an admirable review volume in condensed form. The subject matter treated ranges from simple addition to square and cube roots, and includes chapters on percentage, weights and measures, electrical and heat units and the checking of arithmetical problems. The author, in his preface, lays great stress upon short methods of procedure, but these occupy a minor place in the volume and are already well known to all who work with figures to any considerable extent. By far the greatest part of the space is devoted to problem solution by standard methods. As a guide for review, the book is admirable; it is too condensed, however, to serve as a text for new students. It is unfortunate that many of the line cuts suffer from over-reduction; some of them are almost illegible.

Moscow Sewage Research Reports

REVIEWED BY GORDON M. FAIR
Associate Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

BULLETINS OF THE SEWAGE RESEARCH COMMISSION OF THE MOSCOW SEWERAGE WORKS—No. 10, 1928: Sewage Purification on the Sewage Farms of Moscow, 1914-23. No. 11, 1929: Biological Observations of Sewage Ponds of Moscow During 1919-20. Each in Russian, but No. 10 has summary in French and No. 11 in German. Paper bound. 2.5 rubles, or $1.25 each, from the commission, as noted above.

Although the subjects treated in these reports are of little practical importance on this side of the Atlantic and although their contents, except for the summaries mentioned in the heading given above, are printed in Russian, it seems worth while to indicate their contents as showing the lines of sewage research being carried on at Moscow.

Bulletin 10 opens with A Hydrobiological Study of the Purification Effected by Broad Irrigation, 1912-15, by K. K. Barsoff. Monthly biological examinations of samples from the open drains in the sewage fields showed a high correlation between chemical and biological analyses, and the study prompted simplification of the analytical control of the fields. Next, Operating Results [chemical] of the Moscow Sewage Farms, June, 1914, to May, 1923, are summarized by K. N. Korolkoff. There follow three supplements: (1) The Loss of Nitrogen During Purification and Its Value in Judging the Purification Effected, by K. N. Korolkoff, in which reduction in the nitrogen content during purification by the soil and by biological beds is attributed to denitrification of the nitrates and nitrites. (2) Causes of Increased Chloride Content in the Effluent From Sewage Farms, by K. N. Korolkoff, attributed to evaporation during summer and freezing during the winter. (3) A Critical Note on the Balance Sheet Used to Measure the Purification Effect, by K. N. Korolkoff, showing the difficulties of setting up a balance sheet to judge the biochemical purification accomplished on the sewage fields.

Bulletin 11, by N. G. Zakharoff, is a study of the purification of raw sewage in large ponds arranged singly or in series of four, in which the sewage is held for sixteen or eighteen days. Determinations were made of the ecological position of different micro-organisms found in the ponds. Activities of the plankton which produce self-purification are reviewed. Satisfactory biological purification seems to be restricted to the summer months. In the autumn purification is more and more reduced to clarification by sedimentation. For depths of about 16 in., the maximum sewage load the ponds can receive is about 14,000 gal. of sewage per acre per day. Certain organisms in the Moscow sewage are shown to differ in their ecology from the accepted standards of Kolkwitz and Marsson. In another paper, on Ponds for Sewage Treatment as Judged by Chemical Analysis, 1919, by E. T. Konstantinowa, the purification effected in sewage ponds arranged in series of four is discussed. Limiting loads for summer and winter operation are given.

Second Number in Transportation Series

TRANSPORTATION IN THE MISSISSIPPI AND OHIO VALLEYS—Transportation Series No. 2. Prepared by the Board of Engineers for Rivers and Harbors, War Department, and the Bureau of Operations, United States Shipping Board. Paper; 6x9 in.; pp. 257; many line cuts, halftones and folding plates. $1.25 from Superintendent of Documents, Washington, D. C.

This survey of the water transportation situation in the Ohio and Mississippi valleys is the second of a series on water transportation. The first of the series covered transportation on the Great Lakes. The physical condition of the many navigable channels throughout the two river valleys and the tributaries, including the depths of the various channels, are covered fully by descriptive matter and charts. The many terminals also are described and their facilities for handling and storing freight are enumerated. A brief description of each port throughout the whole network of waterways is given, also the character of the commerce handled and the various major classifications. The book is generously illustrated with maps, graphs and photographs and includes numerous tabulations.

Welder's Handbook

THE OXYACETYLENE WELDER'S HANDBOOK: A Complete and Practical Manual of Modern Practice—By M. S. Hendricks, Editor, *Acetylene Journal*. Chicago: The Acetylene Journal Publishing Co. Flexible; 4½x6¾ in.; pp. 208; illustrated. $3.

In a book of this kind, directed almost solely to the welding operator, there is necessarily much that is elementary. At the same time welding supervisors and fore-

men should gain something from it by reviewing, in fairly condensed form, those principles which they are charged with teaching. The author rightfully impresses upon his readers the importance of inspecting the weld, but his treatment of the subject is rather too brief and superficial to be adequate, particularly for the conservative engineer who is considering welding as a method applicable to structural steel. Also, the chapter on testing could have been expanded with profit. By and large, this handbook should assist the structural welder if he is able to translate the information given into terms of structural welding, for it is quite apparent that the book was prepared for the welders of tankage, pipe, sheet metal and aircraft.

Water Supply Made Interesting

THE STORY OF WATER SUPPLY (The City and Country Series)—By Hope Holway. With pictures by Elmer Hader. New York and London: Harper & Bros. Cloth; 5x8 in.; pp. 134; illustrated. $1.25.

A dramatic story of water-supply history, its part in the present-day congestion of urban life and some technique of its treatment are embodied in this book, which is one of a popular series designed for the use of the younger generation. Members of the elder group, not specialists in the field, could also read the book to advantage. The data presented are correctly stated and checked, the definitions define and enough of romance and hardship endured by superintendents and operators are told to warrant the water-works fraternity recommending the book to their laymen friends, newly elected officials or high school seniors. The author has helped her engineer husband prepare more than one article for *Engineering News-Record* on water-works projects. The book will not lead anyone to feel he can design or run a water-works, but a reading will give one an idea of the fascination of the subject and a wholesome regard for those who do design, build and operate plants.

Publications Received

A BIBLIOGRAPHY OF SEISMOLOGY, to be published quarterly, has been started by the Dominion Observatory of Ottawa, Ont. The first issue covers the first three months of 1929 and is prepared by Ernest A. Hodgson.

MEASUREMENT OF STREAM VELOCITY BY AIR BUBBLES, by Otogoro Miyagi, is the subject of a paper occupying 14 pp. of Vol. VIII, No. 4, of Technology Report of the Tohoku Imperial University, Sendai, Japan. The paper gives a method for determining the size of bubbles and inserts a formula for determining mean stream velocity by the bubble method described.

OF TWO STUDIES OF DOMESTIC HEATING recently published, one takes up the oil burner and the other deals with various fuels burned in a domestic hot-water boiler. The first is by Arthur H. Fenner, assistant mechanical engineer, division of agricultural engineering, Bureau of Public Roads (20c. from Superintendent Public Documents, Washington, D. C.). The second is by E. S. Mallock and C. E. Baltzer (20c. from Canadian Department of Mines, Ottawa, Ont.).

THE STRUCTURAL DESIGN of the Pantheon in Rome is briefly discussed by Dr. Gilberto Bagnani, archæologist, in a thin quarto pamphlet published by the Atlas Portland Cement Company, 25 Broadway, New York City. Dr. Bagnani develops a logical theory of this remarkable building, particularly regarding the structural engineering displayed in constructing and supporting the dome. Pen drawings and halftone views contribute to this intensely interesting account of one of the structures that have been preserved as a record of achievement of the ancient Roman engineers.

THE SUPERIORITY OF THE STEEL BRIDGE is the title of a 47-p. pamphlet published by the American Institute of Steel Construction, Inc., 200 Madison Ave., New York City. Most of the pamphlet is filled with half-tone reproductions of famous steel bridges throughout the world, many of which are striking. In its text matter, the booklet discusses the steel bridge in terms of beauty, strength, permanence, flexibility, movability and economy.

UTILIZATION OF TOP LOGS AND SMALL TIMBER by means of the Scandinavian gang saw has been the subject of experiments carried on by the national committee of wood utilization of the U. S. Department of Commerce at the mill of a lumber company in Washington, where a machine was set up to saw Douglas fir. The results of the tests are published in a report of the subcommittee on gang sawing of lumber which is to be printed later, but is now available in mimeograph form. The Scandinavian gang saws have proved that the conversion of small, low-grade logs between 8 and 20 in. in diameter is profitable under commercial conditions, according to the report.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

A.S.T.M. TENTATIVE STANDARDS, 1929. Philadelphia: American Society for Testing Materials, 1315 Spruce St. Paper; 6x9 in.; pp. 901; many illustrations.

ARCTIC AND WESTERN HUDSON BAY DRAINAGE (and Mississippi Drainage in Canada) in Alberta, Saskatchewan, Manitoba and Western Ontario. Climatic Year 1926-27—By C. H. Attwood, A.M.E.I.C., District Chief Engineer, Winnipeg, Man., and J. S. Tempest, M.E.I.C., Commissioner of Irrigation, Calgary, Alta. Ottawa: Dominion Water Power and Reclamation Service. Paper; 6½x10 in.; pp. 224; maps.

BASIC PRINCIPLES OF CONCRETE MAKING—By Franklin R. McMillan, Director of Research, Portland Cement Association, with an Introduction by F. E. Schmitt, Editor, *Engineering News-Record*. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; p. 99; 32 line cuts and halftones. $2.

DIE BERECHNUNG VON KREISFORMIG BEGRENZTEN PILZDECKEN bef Zentral-symmetricher Belastung—Von Dr.-Inc. K. Hajnal-Kónyi. Berlin: Julius Springer. Paper; 7x10 in.; pp. 135; 26 line cuts; 27 tables. 12 marks.

A mathematical study of circular mushroom slabs.

CARNEGIE SHAPE BOOK—Profiles, Tables and Data for Rolled Products, Shapes, Plates, Bars and Rails (Tenth Edition). Pittsburgh: Carnegie Steel Co. Flexible, 5x8 in.; pp. 371.

A new edition of this handy book is now being distributed to users of rolled steel products. It contains profiles of the new Carnegie beam sections and of all other sections rolled on the structural, bar, plate and rail mills of the Carnegie Steel Co. Complete engineering data, properties and safe loads and other information useful to engineers, architects and designers of steel structures will be given in the 24th edition of the Carnegie Pocket Companion, which will be ready some time in 1930.

CENTRAL ELECTRIC STATIONS IN CANADA—Census of Industry, 1927. Paper; 6½x10 in.; pp. 59; tables. 25c. from Canadian Department of Trade and Commerce, Ottawa, Ont.

Text and statistical tables of summaries only, for all Canada and for each province—printed in both English and French.

CHICAGO: A More Intimate View of Urban Politics—By Charles Edward Merriam, Professor of Political Science in the University of Chicago. New York: The Macmillan Co. Cloth; 6x9 in., pp. 305. $3.50.

THE CITY OF TOMORROW and Its Planning—By Le Corbusier, translated from the 8th French Edition of Urbanisme, with an introduction by Frederick Etchells. New York: Payson & Clarke, Ltd. Cloth; 7½x10 in.; pp. 301; line cuts and halftones. $7.50.

CITY PLANNING: A Series of Papers Presenting the Essential Elements of a City Plan—Edited by John Nolen. Second Edition. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. 513; illustrated. $3.50.

EFFECT OF ALKALINE SUBSTANCES on Sewage Sludge Digestion—By Anthony J. Fishcher, Dorr Sewarge Research Fellow; Willem Rudolfs, Chief of Sewage Investigations; P. J. Alwin Zeller, Chemist, Sewage Investigations. New Brunswick, N. J.: State Agricultural Experiment Station. Paper; 6x9 in.; pp. 34; tables and 17 line cuts.

ERGEBNIS DES IDEENWETTBEWERBES für die drei Rheinbrucken bei Mannheim—Ludwigshafen, Speyer und Maxau—Von Wilhelm Weyher, Reichsbahnbaumeister, Berlin. Berlin: Julius Springer. Paper; 9½x12½ in.; pp. 40; 114 illustrations. (Reprinted from Der Bauingineur, 1929.) 3.6 marks.

Text and many illustrations showing competitive designs for three steel bridges.

FARM DRAINAGE— By Lewis A. Jones, Senior Drainage Engineer, Division of Agricultural Engineering Bureau of Public Roads. Farmers' Bulletin No. 1606. Paper; 6x9 in.; pp. 25; 18 halftones and line cuts. 5c. from Superintendent of Documents, Washington, D. C.

FINANCIAL STATISTICS OF CITIES Having a Population of Over 30,000 (1927)—Cloth; 6x9 in.; pp. 503; line cuts. $1.25 from Superintendent of Documents, Washington, D. C.

THE HARDNESS OF STEEL BALLS Used for the Determination of the Brinell Hardness Numbers of Materials—By R. G. Batson, A.K.C., M.Inst. C.E., M.I.Mech.E., and S. A. Wood, M.Sc.

(National Physical Laboratory). Engineering Research Report No. 16. London: H. M. Stationery Office, Adastral House, Kingsway. New York: The British Library of Information, French Buildings, 5 East 40th St. Paper; 6x9½ in.; pp. 30; line cuts and tables. 1s. 3d.

HIGHWAY CURVES—By Howard Chapin Ives, C.E., Consulting Engineer. New York: John Wiley & Sons. London: Chapman & Hall. Flexible; 4x7 in.; pp. 247; illustrations and tables. $3.50.

HIGHWAY LOCATION AND SURVEYING—By W. W. Crosby, M.Am.Soc.C.E., etc., and George E. Goodwin, M.Am.Soc.C.E., Formerly Chief Civil Engineer, National Park Service, U. S. Department of the Interior. Chicago: Gillette Publishing Co. London: E. & F. N. Spon, Ltd., 57 Haymarket. Cloth; 5¾x8 in.; pp. 398; illustrated. $4.

MICROSCOPIC EXAMINATION OF THE ORE MINERALS—By W. Myron Davy and C. Mason Farnham. Second Impression. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 154; illustrated. $2.50.

MITTEILUNGEN DES HYDRAULISCHEN INSTITUTS der Technischen Hochschule München—Herausgegeben von Institutsvorstand D. Thoma, Dr.-Ing., o. Professor. Heft 3. München und Berlin: R. Oldenbourg. Paper; 8x11 in.; pp. 163, 233 line cuts and halftones. 12 marks.

Ten papers on friction losses in elbows, angular branches, lapped joint pipe, etc., on errors on weir measurements and on other branches of hydraulic research.

OUR CITIES TODAY AND TOMORROW: A Survey of Planning and Zoning Progress in the United States—By Theodore Kimball Hubbard, Hon. Librarian, American City Planning Institute, and Henry Vincent Hubbard, Norton Professor of Regional Planning, Harvard University, Editor of *City Planning*. Cambridge: Harvard University Press. Cloth; 7x10 in.; pp. 389; illustrated. $5.

THE PLASTER-MODEL METHOD of Determining Stresses Applied to Curved Beams—By Fred B. Seely, Professor of Theoretical and Applied Mechanics, and Richard V. James, Graduate Student in Theoretical and Applied Mechanics (Associate Professor of Mechanics, University of Oklahoma). Engineering Experiment Station Bulletin No. 195. Urbana: University of Illinois. Paper; 6x9 in.; pp. 36; illustrations and tables. 20c.

THE PUBLIC WORKS DEPARTMENT in American Cities—By Clarence E. Ridley, National Institute of Public Administration. Publication No. 13. New York City: Municipal Administration Service, 261 Broadway. Paper; 6x10 in.; pp. 51; illustrated. 35c.

Analytical study with summaries of data on 25 American cities of from 2,000,000 to 32,000 population, with organization charts.

REDOGORELSE for Undersokningar Angaende Orsakerna Till Forstorelse av Beton—Axel Ekwall, Chief Engineer, the Royal Board of Waterfalls. Stockholm 1: Kungl. Vattenfallsstyrelsens Byggnadsbyra. Paper; 6x9 in.; pp. 145; 51 illustrations.

Preliminary report of the Royal Board of Waterfalls of Sweden on the cause of deterioration of concrete in hydraulic structures. Has a 3-p. summary in English.

REPRESENTATIVE INTERNATIONAL CARTELS, Combines and Trusts—By William F. Notz, U. S. Bureau of Foreign and Domestic Commerce. Paper; 6x9 in.; pp. 76. 15c. from Superintendent of Documents, Washington, D. C.

Aluminum, steel and six other cartels reviewed.

SUPPORTING STRENGTH OF CONCRETE-INCASED CLAY PIPE Determined From Tests With Commercial Vitrified Salt-Glazed Clay Pipe—By W. J. Schlick, Drainage Engineer, Engineering Experiment Station. An investigation conducted at Ames, Iowa, by the Iowa Engineering Experiment Station in Co-operation with the Clay Products Association, Chicago. Ames, Ia.: Iowa State College. Paper; 6x9 in.; pp. 64; line cuts, halftones and tables.

SUSPENDED MATTER IN THE COLORADO RIVER IN 1925-1928—By C. S. Howard. Water-Supply Paper 636-B., U. S. Geological Survey. Paper; 6x9 in.; pp. 44; illustrated.

TABLES OF SQUARES: A Handbook for Bridge and Structural Draughtsmen, Architects, Civil and Mechanical Engineers and Estimators—By John L. Hall. Third Edition. Seattle: The author, 4409 White-Henry-Stuart Building. Flexible; 3½x5¾ in.; pp. 100.

Correction of "a few minor errors" found on "thorough-going re-examination" have been made in the present edition of this book, first published in 1899.

TECHNISCHE HOCHSCHULE DANZIG, 1904-1929. Danzig: A. W. Kafemann, G.m.b.H. Paper; 6½x9 in.; pp. 344; many illustrations and tables.

Numerous papers in celebration of the 25th anniversary of the school mentioned, grouped under teaching and research, mathematics and physics, chemistry, architecture, civil engineering, machine building, electricity, shipping and aviation.

UBER DIE ENTWICKLUNG DER NEUEREN ABWASSER-REINIGUNGSVERFAHREN—Von Dr.-Ing. Max Prüss, Marinebaurat a.D. Reprinted from "Jahrbuch der Deutschen Gesellschaft für Bauingenieurwesen, 1928." Address the author, Essen, Germany. Paper; 6x8 in.; pp. 40; 16 illustrations.

THE UNIVERSE AROUND US—By Sir James Jeans, M.A., D.Sc., LL.D., F.R.S., New York: The Macmillan Co. Cambridge, England: University Press. Cloth; 6x9 in.; pp. 340, including Index; illustrated. $4.50.

VORLESUNGEN UBER EISENBETON—Von Dr.-Ing. E. Probst, ord. Professor an der Technischen Hochschule in Karlsruhe. Zweiter Band. Berlin: Julius Springer. Bound; 6x9 in.; pp. 539; line cuts and tables. 31.5 marks.

WATER SUPPLY ENGINEERING—By Harold E. Babbitt, Professor of Sanitary Engineering, University of Illinois, and James J. Doland, B. S., C.E., Assistant Professor of Sanitary Engineering, University of Illinois. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 776; tables and illustration. $6.

WIRTSCHAFTSFÜHRUNG UND FINANZWESEN BEI AMERIKANISCHEN EISENBAHNEN—Von Dr. jur. et rer. pol. Ludwig Hoberger, Reichsbahndirector und Mitglied der Hauptverwaltung de Deutschen Reichsbahn-Gesellschaft Minister a.D. Berlin: Deutschen Reichsbahn. Paper; 6x8 in.; pp. 105. 4.80 rm.

Letters to the Editor

Dry Concrete Used on Two Large Dams —Correction

Sir—I wish to call your attention to a slight typographical error in your Oct. 24 issue in the article "Exceptionally Dry Concrete Used on Two Large Dams." It will be found on p. 641, paragraph 2, line 5. Water-cement ratio "0.05" should read "0.95." W. R. JOHNSON.

Calderwood, Tenn., Nov. 12, 1929.

Wind Vibration

Sir—I have noted with interest the editorial in *Engineering News-Record*, Oct. 24, 1929, p. 637, bearing the title "Wind Vibration Again." The editorial conveys the impression that the failure of certain long hangers in the recently completed Palmyra-Tacony bridge over the Delaware River was probably due to resonant vibration.

The writer feels that a careful computation of combined stresses from vertical dead load and a wind pressure of 50 lb. per square foot, acting in a direction parallel to the axis of the bridge and therefore exerting its maximum effect upon the hangers, would show that at the time of failure the hangers probably were subjected to a unit stress at the end connections which was not far from the elastic limit of the material. In this event, it seems unnecessary to call upon the somewhat mysterious forces of "resonant vibration" in order to account reasonably for the failure.

FRANCIS P. WITMER,
Director, Department of Civil Engineering,
Philadelphia, Pa., Towne Scientific School,
Oct. 31, 1929. University of Pennsylvania.

Garages in Multi-Family Zoning Districts

Sir—I have read with interest the editorial in your issue of Oct. 24 on "A Reform Needed" in zoning laws where garages are not permitted in multiple-family home districts.

The city of St. Paul, Minn., recognized this situation some years ago, and in December, 1924, amended its comprehensive building zone ordinance. Under "Use District Limitations and Exceptions" in defining "accessory uses" the ordinance of 1922 was amended to read:

"A private garage for more than five motor vehicles in which more than one automobile is stored for other than occupants of the premises or more than one of which is a commercial vehicle shall not be deemed an accessory use in single-family home districts or in two-family home districts. In apartment-house or multiple-family districts a private garage not having an entrance within 60 ft. of the front street line and in no case directly off from any street and not housing a greater number of motor vehicles than the number of separate dwelling apartments located on the same lot or plot not more than one of which is a commercial vehicle and where no repair facilities, service station or other business is maintained may be deemed an accessory use."

This has worked out exceedingly well under our conditions. Apartment houses are provided with facilities for storing one car for each family either in the apartment building or adjacent to it. This permits the designing of apartment-house buildings for garages as well as for families, and also permits the older apartment houses without garage facilities to provide for them where they own or acquire the land for doing so. GEORGE H. HERROLD.

St. Paul, Minn., City Planning Engineer.
Nov. 2, 1929.

News of the Week

Boston & Maine R.R. Announces Construction Program

Plans for the improvement of the Boston & Maine Railroad lines involving the construction of new bridges and the rebuilding of several stretches of roadbed have been announced. The estimated cost of the program is $3,000,000. Included in the project are new steel bridges over the Connecticut River at Windsor, Vt., and over the canal at Bellows Falls, a new bridge over Saxton's River south of Bellows Falls, and new bridges at Nashua, Merrimack, Goffs Falls and Hooksett, the latter over the Merrimack River. Reconstruction of a number of existing bridges is planned and revision of line and grade on an extensive scale will be carried out. Work will continue steadily during the coming year and completion is expected in about a year.

Goodyear Company Extending Airship Activities

The building in Akron, Ohio, of two commercial Zeppelin-type airships and the erection of a second airship factory and dock similar to the one now nearing completion at the Akron municipal airport (illustrated on p. 828 of this issue); the construction of another similar hangar in southern California, and the building of airship mooring masts in Hawaii and the Philippines, are included in the plans for commercial airship development just announced by Paul W. Litchfield, president of the Goodyear Tire & Rubber Company and the Goodyear-Zeppelin Corporation.

Board Investigating Safety of San Gabriel Dam Site

The board of engineers and geologists appointed by Edward Hyatt, state engineer of California, to make an investigation into the safety of the San Gabriel dam site, met in Los Angeles Nov. 12 and are now at work. The personnel of the board was noted in *Engineering News-Record*, Nov. 7, p. 742.

The investigation is expected to consume about two weeks' time, and then a report will be compiled for submission to the state engineer. The preparation of the report probably will take two or three weeks.

At the request of the Los Angeles County Board of Supervisors, F. H. Fowler, Wayne Loel, Andrew C. Lawson, J. W. Reagan, F. J. Safely, Allen Sedgwick, Robert Hill, Louis C. Hill and Dr. F. C. Tolman, engineers and geologists, are making individual reports on the dam site. These men on different occasions in the past have reported on the San Gabriel site and now have been asked to make new reports "in the light of newly discovered data."

Power Development Program Under Way in British Columbia

The Powell River Pulp & Paper Company has commenced its power development program by awarding a $125,000 contract to the Stuart Cameron Construction Company, of Vancouver, B. C., for clearing the right-of-way and erection of a transmission line. This line will be 12½ miles long and will link the mills of the firm and the existing power plant at Powell River with the projected plant on Lois River, which will have a capacity of 18,000 hp.

American Firm to Build Russian Industrial Plants

Contracts for the construction in Russia of a chain of cement plants, grain elevators, flour mills and other industrial establishments aggregating $110,000,000 in value have been awarded by the Soviet Union to the MacDonald Engineering Company, Chicago, Ill., on a cost-plus-fixed-fee basis. Material, labor and capital are to be supplied by the Russian government, while the design and supervision of the work will be carried on by a staff of American engineers. Included in the program are four cement plants and five flour mills and grain elevators. A large amount of American machinery will be used in the construction and equipment of the plants.

State Highway Officials in Convention Emphasize Finance

Largest Convention in History of Association of State Highway Officials Held at San Antonio, Tex—600 Delegates From 45 States

Engineering News-Record Staff Report

BETWEEN 500 and 600 delegates from state highway departments registered at the annual convention at San Antonio, Tex., last week of the Association of State Highway Officials. Texas, with 200 of its department employees present, led in the number of delegates in attendance from one state and highway officials from 45 of the 48 states answered the roll call. As usual, there was a large attendance of engineers of the U. S. Bureau of Public Roads and for the first time a delegation from the Mexican Federal Highway Department. Altogether this convention was the largest in attendance of delegates ever held by the association.

The convention proceedings occupied three days (Nov. 12, 13 and 14), allotted largely to group sessions, with eight groups in session simultaneously morning and afternoon of one day. The official sessions of the thirteen standing committees occupied one entire evening. Besides the address of the president and the report of the secretary, there were only five papers presented in general sessions—one on low-cost roads by T. H. Cutler, one on prequalification of contractors by P. H. Tebbs, one on interrelation of highways and airways by C. H. Purcell, one on roadside development by G. C. Dillman and one on highway financing by Thomas H. MacDonald.

With the address by Governor Moody advocating the financing of Texas highways by a bond issue, the report of Secretary Markham on present sources of revenue for state roads and the address of President Fortney emphasizing the diversion of gasoline and other motor-user taxes from state highway construction and upkeep, the paper by Mr. MacDonald completed a notable group of discussions on financing and taxation. Beyond formal resolution on some of the questions raised, however, the convention gave no expression of particular interest in the questions raised.

In regard to gasoline tax diversion President Fortney stated that, beginning with next January, every state in the Union except seven will be giving some portion of its gasoline tax receipts to the counties, and in a number of states there was an even greater diversion to public uses having no connection with public roads service. With more than 80 per cent of the total highway traffic confined to state roads and less than 50 per cent of the state road mileage improved to a degree which economically cares for the traffic, this diversion of funds raised by taxing the road user is unwise and unjust. During the present year the states have added some 20,000 miles of surfacing and 6,700 miles of road graded to engineering standards. With these additions some 183,000 miles of the 310,000-mile state system are provided with some kind of surfacing. For the work done this year there was made available a little more than a billion dollars; of this, the states paid $825,000,000.

More detailed figures of income, ex-

penditure and performance were given by Secretary Markham in his annual report. Referring to the motor vehicle tax, the report stated that one state highway department, Montana's, received nothing, while the percentage received by the remaining states ranged from 3.5 to 72.4 per cent. In respect to the gasoline tax, a tabulation showed that 41 states by change of law or increase of rates now divide the gas tax with the counties. All states now have a gasoline tax, the lowest rate being 2c. and the highest 6c. Since 1928, 21 states have increased their gasoline tax by 1 or 2c. In closing his report Secretary Markham said:

If I might hazard an opinion as to how the funds for state highways should be divided, I would say 10 per cent from a general levy on all property, 20 per cent from federal funds and the remaining 70 per cent from motor license fees and a gasoline tax, distributed according to local conditions. At present a tax levy, appropriations and miscellaneous receipts almost equal the 10 per cent of a general levy. All wealth receives some benefit from these public improvements and should contribute this small percentage, thus eliminating the other methods now used, including local funds.

The discussion was concluded by Mr. MacDonald by an emphatic argument in favor of financing state roads by state bond issues. The issuance of county bonds for state roads was condemned. Mr. MacDonald said:

There is not a single valid argument against the issuance of bonds for road improvement as a fiscal matter. It is possible for those seeking public office to secure votes against bonds by capitalizing old prejudices and the characteristic fear of debt. Certainly, in the face of the experience of the states which have made the most rapid progress in road improvement and which have advanced a part of the costs from bonds, there is not a single unfavorable situation or circumstance to support anti-bond arguments.

When fanatical advocates of the pay-as-you-go plan utter their dire prophecies of the disaster that must follow upon the heels of a borrowing policy, I am constrained to doubt the knowledge of the remarkable benefits that have attended that policy in the states that have made the greatest advance in the improvement of their highways. These gentlemen would have us believe that there are certain commonwealths whose people, preserving the ancient American ideals of honesty and frugality, rigidly refrain from borrowing capital for road improvement as a matter of principle. To believe them is to believe that these homely ideals continue to reside in just one of our 48 states, for there is just one, the State of North Dakota, in which thus far there has been no resort to a bond issue either for state or local road improvement. If state bond issues alone are immoral, then there are seventeen sovereign states that are free of taint, but the remaining 31 states are convicted on their record.

The people of the seventeen states that have issued no state bonds have 32,066 miles of roads improved with surface of bituminous macadam, or better, to show for their total of debt of $657,072,787. For each mile of such high-type roads there is, or was in 1926, an outstanding indebtedness of $20,500 per mile, on every dollar of which they are paying a relatively high rate of interest.

The people of the remaining 31 states have a combined county and state indebtedness of $1,621,745,426, to show for which they have 70,493 miles of roads with surface equal to or better than the bituminous macadam. The indebtedness is at the rate of $32,000 per mile of such high-type roads, and on more than half of it the people are paying a minimum rate of interest.

Roadside Development

The value of state parks was emphasized by G. C. Dillman in his address on the subject of parks and highway beautification, when he declared that in Michigan the number of visitors to the state parks was 220,000 in 1923, and that in 1929 the total number of visitors was 7,454,000, traveling there in 1,500,000 automobiles. State parks, he said, have not only proved to be ideal places of recreation for the motoring public but are also serving as game preserves, because no hunting is permitted in these parks. Provision should be made to enable highway authorities to trim properly and otherwise care for existing trees and shrubs, to plant trees, to set out flowers and shrubs, to cut noxious weeds, to destroy litter and rubbish found along the road, to supervise planting by individuals and to control the erection of advertising signs at road intersections and railroad crossings, even though such signs are on private property.

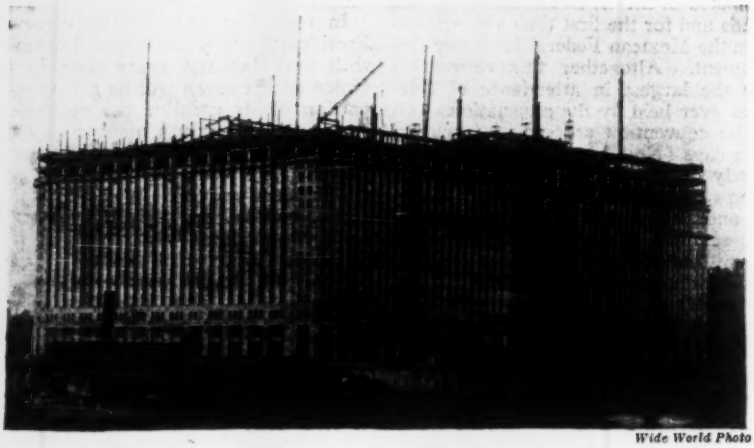
Control by Highway Authorities

It is just as important, or perhaps more important, that the enforcement and carrying into effect of all the laws requisite to roadside developments be vested in highway authorities. Some very commendable pioneer work has been done by civic and patriotic organizations as well as legally constituted authorities other than highway authorities, and through the joint action of all these, but it is believed the public interest will be more economically and efficiently served by placing all of the details of roadside developments under the exclusive control of the highway authorities.

Technical Reports

Reports were made by each of the thirteen standing committees on technical development in the design and construction of pavement and structures and on research and materials, maintenance and accounting. These reports mainly recited continuation of work long in progress and summarized new developments and developments in contemplation.

ERECTING THE WORLD'S LARGEST BUILDING



Wide World Photo

Construction is going rapidly forward on the Merchandise Mart, the large building on the Chicago River opposite Wacker Drive which will contain 53,000,000 cu.ft., exceeding by far the cubic contents of any other building in existence. The frontage along the Chicago River is 724 ft. Besides the eighteen floors in the main structure, there will be a tower in the central portion of the building containing five additional stories. Graham, Anderson, Probst & White are the architects of the building.

Kansas and Colorado in Dispute Over Water Rights

Arguments on the Kansas-Colorado dispute over Arkansas River waters began in Denver Nov. 4 and will continue at various points throughout 1930, it is predicted, before the matter will be taken to the U. S. Supreme Court for adjudication. Record of testimony is being taken by Milton Atwood, stenographic commissioner of the Supreme Court.

The case is an outgrowth of disputes over the 1907 decree in which water was allocated to the contending states. Kansas was accused of infringing Colorado's rights, particularly in Finney County, several years ago. Since then Kansas instituted three different suits in district court. Colorado asked that Kansas be enjoined from proceeding with these suits, and the result was that the highest court agreed to reopen the 1907 case under direct jurisdiction.

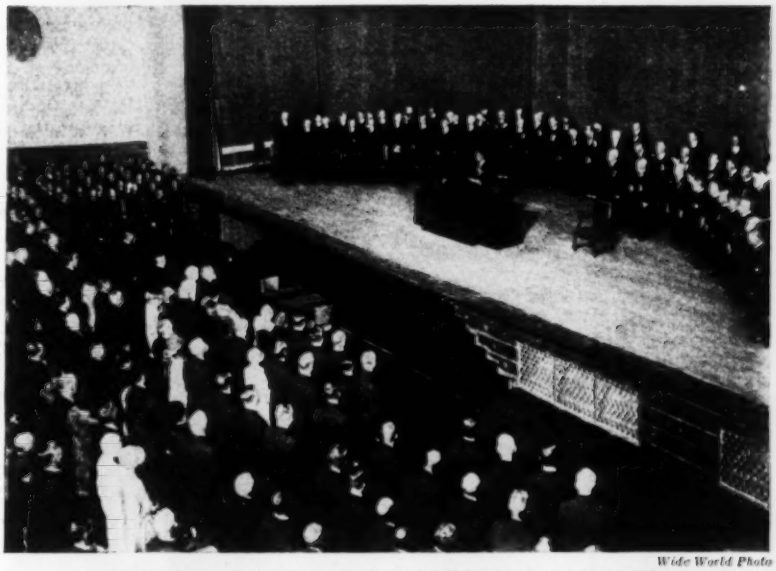
Investigation of Lake Kootenay Power Project Ordered

Investigation by engineers of the project on Lake Kootenay proposed by the West Kootenay Power & Light Company, of British Columbia, has been ordered by the International Joint Commission following a hearing held at Bonners Ferry, Idaho. At the hearing the Canadian power plans were considered in the light of protests by Idaho farmers that raising of the Lake Kootenay water level would result in inundation of diked and reclaimed lands in northern Idaho.

Robert Crowe, counsel for the power company, argued at the hearing held Nov. 6 and 7 that the power shortage in British Columbia is acute and that service is desired for the Consolidated Mining & Smelting Company of Trail, B. C., which plans to construct a fertilizer plant to utilize smelting fumes which now are damaging lands in Stevens County, Wash.

Nearly a hundred owners of reclaimed lands in northern Idaho attended the hearings to press their claims that the damming of Kootenay Lake would result in flooding their valuable reclaimed lands. The present plans call for construction of a dam in Kootenay River at Granite, Idaho, the end of the lake.

The International Joint Commission has authorized the power company to excavate for the dam, as preliminary work will not affect the lake level. American interests asked that the final decision be postponed for a year to allow the landowners opportunity to investigate probable effects of the project. The commissioners agreed that definite data relative to possible damage to Idahoans must be secured before final decision can be reached.



Wide World Photo

OPENING OF WORLD ENGINEERING CONGRESS

The World Engineering Congress, which was held in Tokyo, Japan, in October, with representatives of 26 countries in attendance, was opened by Prince Chichibu, heir presumptive to the Japanese throne. The opening session was held in the public auditorium in Hibiga Park, and the illustration shows the Prince delivering the inaugural address to the delegates.

Adverse Report on Deepening of Barge Canal

U. S. army engineers have filed an adverse report with the Chief of Engineers on a project for deepening the New York State Barge Canal to 14 ft., which report was requested at the present session of Congress by a resolution of the committee on rivers and harbors. The board consisted of Col. G. M. Hoffman, Lieut.-Col. R. T. Ward and Major Eugene Reybold, the latter being district engineer at Buffalo, N. Y., and recorder of the board. Members of the board visited Oswego and conferred with the Harbor and Dock Commission, and also inspected the St. Lawrence River canals and the Barge Canal from Oswego to Albany, N. Y. The engineers rendered an adverse decision because of the excessive cost and the expected change in canal traffic with the opening of the new Welland Canal between Lake Erie and Lake Ontario.

The New York State Chamber of Commerce at its November meeting approved the recommendation of two of its committees that President Hoover be requested to assign army engineers to study the feasibility of a ship canal connecting the Hudson River and the Great Lakes.

Structural Welding Discussed

Among the subjects presented at the three-day annual meeting of the International Acetylene Association in Chicago were the uses of gas welding and cutting for structural steelwork, piping, airship framing and machine repair work. For the structural session the program included: "Gas Welding and Cutting in Structural Steel," by H. H. Moss, Linde Air Products Company, New York; "Design and Fabrication of Oxyacetylene Welded Buildings," by H. M. Priest, assistant engineer of the American Bridge Company, New York, and "Erection of Steel Structures by Welding," by George H. Holcombe, contractor, Forestville, N. Y. Mr. Moss, in a general review of the situation, stated that welding results in economy both in the design and in the erection. The warping difficulty is confined to connection details and can be controlled in design. Fillet welds have advantages in tensile strength and ductility, while for economy a short heavy weld is better than a longer and lighter weld.

The Morehead medal for research in the metallurgy of welding was awarded to the late Samuel Wylie Miller. Officers for 1929-1930 are as follows: president, C. A. McCune, American Chain Company; vice-president, W. G. Flannery; secretary (re-elected), A. Cressy Morrison, Union Carbon & Carbide Corporation, New York, N. Y.

Effective North Carolina Annual Water Works and Sewage Meeting

More than 300 engineers, operators and state and municipal officials attended the ninth annual meeting of the North Carolina Section of the American Water Works Association and the seventh annual conference of the North Carolina Sewage Works Association held jointly Nov. 4-6 at High Point, N. C. The program was largely devoted to the discussion of subjects of special bearing on water-supply and sewage problems of North Carolina. A summary of the Toronto convention of the American Water Works Association was presented by J. O. Craig. Several general subjects also were considered, among these being the following: "Aerotopographic Surveys," by O. H. Brown, of the Curtiss Flying Service; "The Relation Between City Planning and Water and Sewerage Facilities," by C. W. Smedburg, superintendent of the water department of Greensboro, N. C.; "Natural Purification Capacities of Streams," by H. W. Streeter, of the Cincinnati office of the U. S. Public Health Service, and "Laboratory Control of Sewage Treatment Works," by G. F. Catlett, of the North Carolina State Board of Health.

For some years there has been close and harmonious co-operation between the North Carolina State Board of Health, of which H. E. Miller is chief engineer, the engineering schools of the state and the municipal officials having to do with water and sewage works. Prof. H. G. Baity, of the engineering faculty of the University of North Caro-

lina, and Mr. Miller have worked together in training men to operate these works in that state. As a result, more than 40 operators are college-trained men. This co-operative effort further has been actively supported by municipal officials. The works in charge of these officials, as was frequently brought out in papers and discussions during the meeting, reflect in design and operation the beneficial effect of a proper technical point of view. Industrial sections of the Carolinas are confronted with increasing need for far-seeing planning in all water-supply and sewage problems, as was set forth in a discussion of the local conditions by M. N. Baker in *Engineering News-Record* for Aug. 15, 1929, pp. 255-256. Observations at the recent joint meeting indicate that those charged with the responsibility for such planning are fully alive to the magnitude of their problem. The close co-operation of all who have to do with the operation of water-supply and sewage-works in the state also is insuring a practical maximum of efficiency and protection for the public.

C. W. Smedburg was elected president and Prof. H. G. Baity was re-elected secretary-treasurer of both state organizations for the ensuing year.

Western State Engineers to Meet

The second annual meeting of the Association of Western State Engineers will be held at Reno, Nev., Dec. 9-11. Subjects on which papers will be presented at that time by members of the association, together with the chairman of the committee on each subject are as follows: "Whether the Federal Government or the Several States Shou'd Have the Right to Control the Unappropriated Unnavigable Waters Within the State Boundaries," M. C. Hinderlider, Colorado, chairman; "To Help Stabilize the Commercial Phases of the Use of Water by Encouraging the Perfecting of the Laws Relating Thereto and by Other Proper Means," Edward Hyatt, California, chairman; "Proposed State Laws Governing Dam Construction," R. K. Tiffany, Washington, chairman; "The United States Reclamation Policy," George W. Malone, Nevada, chairman; "Proper State Control and Protection of Individual Appropriations of Underground Water," Harold Conkling, California, chairman; "Ownership of Return Flow and Its Relation to the Relative Rights of the Stream System," R. I. Meeker, Colorado, chairman; "Range Control in the Western States," H. W. Reppert, Nevada, chairman; "National Legislation of Common Interest to Our Irrigated States," John A. Whiting, Wyoming, chairman; "Irrigation and Drainage District Laws, With Special Reference to Standardization," Thomas R. King, Nevada, chairman.

Key Pittman, United States Senator from Nevada, is scheduled to speak on "The Relation of the Federal Government to the States Relative to the Control of Water Within the States."

Fellow Employees Pay Honor to F. N. Connet

Recently, in the office of Builders Iron Foundry at Providence, R. I., a small group of long-time employees gathered to pay their compliments to their chief engineer, Frederick N Connet, upon his completion of 40 years' continuous service with the concern. After appropriate felicitations he was presented with a wrist watch and asked to wear it in the future as an hourly reminder of the respect and admiration in which he is held by his associates.

F. N. CONNET

The invention of the Venturi tube and the determination of its characteristics in 1887 by Clemens Herschel have been frequently acclaimed by leading engineers as marking an epoch in the annals of hydraulic science. Hardly less in importance are the prolific and conspicuous contributions by Mr. Connet in the invention and design of registering and controlling devices for use with the Venturi tube. Perhaps this has never been better expressed than by the committee on science and arts of the Franklin Institute, June 22, 1898, which referred to his first Venturi register as "having made the Venturi meter available for a host of purposes for which otherwise it could not have been satisfactorily used." In awarding the John Scott legacy premium and medal, for the invention of that register, the report further comments:

"Its invention, design and perfection are the fruits of great ingenuity and of much knowledge and painstaking labor; they have been of vast benefit to the community by making the Venturi meter a practical working tool."

Since the first successful Venturi register (Type D), many of which are still in daily service, Mr. Connet has devised and patented some twenty other types of Venturi meter instruments, originated the first Venturi filter effluent controller, devised the first chemical feed machine to be used with the Venturi tube and successfully applied the Venturi principle to a large number of municipal and industrial problems.

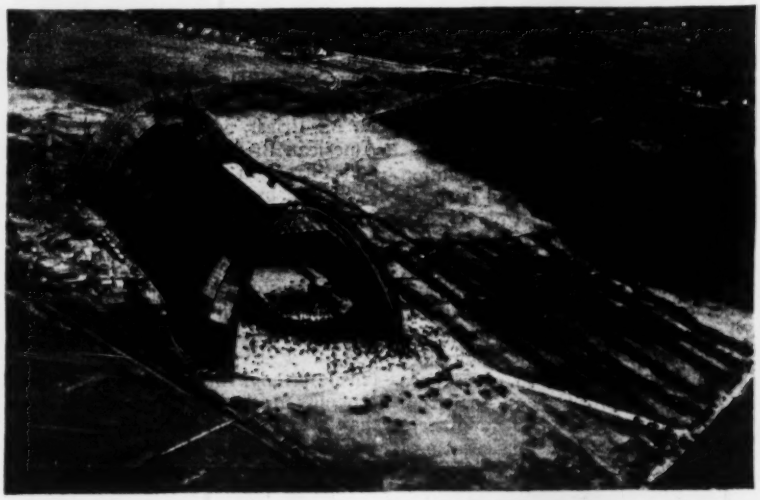
New Steel Arch Bridge Opened in England

On Oct. 31 the new three-hinged steel arch bridge across the Wear at Sunderland, England, was opened to traffic. The structure, known as the Wearmouth bridge, has a span of 375 ft. and a clearance above the water of 85½ ft., and is 80 ft. wide. An old cast-iron bridge, built in 1796, was removed piecemeal and the new one erected without interrupting traffic except at nights and on Sunday mornings. The total cost of the structure was more than $1,250,000.

St. Paul Charter Change Fails

The proposed council-manager charter for St. Paul, Minn., outlined in *Engineering News-Record*, Oct. 31, 1929, p. 706, was defeated on Nov. 5 by a small actual majority and nearly 5,000 votes short of the required 60 per cent of favorable votes. Early returns gave 22,867 votes for and 22,457 votes against the charter, with 51 ballots mismarked. Less than 38 per cent of the registered voters went to the polls, or about 45,000 out of 121,000.

LAYING THE FIRST RING FOR THE U. S. NAVY'S NEW DIRIGIBLE



Construction work on the "ZRS4," the largest airship in the world, now being built in the partly completed dock and factory of the Goodyear-Zeppelin Corporation at Akron, Ohio, started officially with elaborate ceremony when Rear Admiral William A. Moffett and other notables drove a golden rivet into the master ring of the framework recently. This illustration gives an excellent idea of the gigantic size of the dock and of the orange-peel doors.

Brief News

A NEW PASSENGER STATION for the Pennsylvania Railroad on South Clinton Ave., Trenton, N. J., to cost $1,750,000, will be started next spring, it is announced by Vice-President Le Boutillier.

BIDS FOR ELEVEN STEEL BRIDGES across Bulgarian rivers are being solicited by officials of the Bulgarian Railways at Sofia. These must be supplied and erected within seventeen months of the acceptance of the contract.

A NEW ORGANIZATION, the Standards Association of Australia, has been established as the result of the amalgamation of the Australian Commonwealth Engineering Standards and the Australian Commonwealth Association of Simplified Practice.

PURCHASE OF THE WATER-WORKS of Paducah, Ky., by the municipality has been initiated by the board of commissioners. By the terms of the franchise the city has the right to acquire the plant on six months' notice. Paducah's population, according to the census of 1920, was 24,735.

A BROAD NEW HIGHWAY along the East River, New York City, 150 ft. wide, extending from Corlears Hook Park to East 57th St., has been approved by the Board of Estimate and Apportionment. As yet there is no definite plan, but the board approved the project in principle.

A NEW BILLBOARD ORDINANCE prohibiting the erection of any signs along the major boulevards of the city has been passed by the board of supervisors of San Francisco.

FOR POWER PROJECTS at Ariel and Yale, the Northwestern Electric Company has acquired by purchase 400 acres more land on the Lewis River in Washington. The company recently received a permit from the Federal Power Commission to start construction, and states that by spring it will have 1,000 men in the field to begin work on the first unit, estimated to cost $9,000,000. Cost of ultimate development is placed at $50,000,000.

THE CONTRACT FOR BORINGS to determine foundation conditions for the proposed bridge across the Golden Gate, the entrance to San Francisco Bay, has been awarded to E. J. Longyear, contractor, of Minneapolis, Minn., on a bid of $29,940, which was the lower of the two bids opened. The other bid, submitted by the Healy-Tibbitts Construction Company, San Francisco, Calif., was for $79,200.

CONSTRUCTION OF ANOTHER BRIDGE across the Kennebec River in Maine will be started by the state highway commission in the spring. Preliminary surveys are now being made by department engineers to determine the site, which must be close to Richmond Village near the present ferry. It will be financed from the $5,000,000 bond issue for bridges, ratified at the recent election, and will be paid for in tolls. Estimated cost is from $1,000,000 to $1,500,000.

EUROPEAN CEMENT MILLS using bauxite as a raw material are rapidly increasing in number. There are now under construction four new works in Yugoslavia, two in Hungary and three in France, all of which will use this material.

A MASTER PLAN for Monroe County, N. Y., to include seven types of major studies is to be undertaken by the Monroe County Regional Planning Board. The work, which will require five years to mature, will include highways, recreation, transportation, airways and landing fields, port and waterways development, sanitation, drainage and water supply and the use of land.

The Business Outlook

The records for October and the early weeks of November show that a slow and irregular business recession is going on. It has, as usual, affected the basic industries more than general trade. Part of this decline is seasonal or a natural reaction to the excessive expansion during the first half of this year; but part is undoubtedly due to the gloom and uncertainty growing out of continued security price deflation. The steel ingot production rate for the industry as a whole is down to 73 per cent, compared with 78 per cent in the preceding week and 83 per cent a year ago. Heavy construction awards also declined for the week ended Nov. 14.

—The Business Week, Nov. 16

Highway Research Board to Meet

A general program of research will be presented to the Highway Research Board of the National Research Council at its annual meeting to be held in Washington, D. C., Dec. 12 and 13. In addition, some of the committees of the board will present detailed suggestions for research projects coming under their jurisdiction. During the past year the members of the structural design committee have been concentrating on the preparation of a detailed outline of research in the field of structural design of roads which will probably include the following main headings: subgrade, traffic, climate, road types and special problems. The committee on highway traffic analysis will present its report, which includes subjects relating to the factors entering into the efficient use of the highways.

Technical papers to be presented at the meeting include "The Mathematical Theory of External Loads on Closed Conduits in the Light of the Latest Experiments," by Anson Marston, president, American Society of Civil Engineers; "Soil Investigations in Russia," by Dimitri P. Krynine, professor of highway engineering, Moscow Superior Technical School; "Progress Report of Curing Investigation," by F. C. Lang, engineer of tests and inspection, Minnesota, and Fred Burggraf of the Highway Research Board; and "Control of Concrete Making for Pavements," by R. W. Crum, director, Highway Research Board.

Two new committees have been appointed. The committee on mineral aggregates is under the chairmanship of W. J. Emmons and the committee on highway transportation costs is under the chairmanship of T. R. Agg. Arrangements have been completed for conducting a fact-finding study of existing information bearing on the suitability of rail steel for use as concrete reinforcement in highway work. A committee with Prof. R. L. Morrison as chairman has been organized to review the findings of this investigation.

WASHINGTON NOTES

BY PAUL WOOTON
Washington Correspondent

Power Commission Criticised in Flathead Lake Case—Rules Proposed to Regulate Contracts

CONSERVATION, in the form of utilization of waterpower now running to waste, has received a material setback because of the precedent established by the recent hearing before the Federal Power Commission in the Flathead Lake case, in the opinion of those who are following the case closely. In this case the commission set aside its own rules of procedure in taking the hearing out of the hands of its technical staff. This action doubtless was influenced by the support given this demand by two members of the Senate.

The hearing is conceded to have furnished abundant proof that the commission's engineers were right in finding that the company engaged in supplying the region with power is in a better position to utilize the resource in the interest of the public generally. It was possible, however, for a single disappointed applicant, with little evidence of support for his plan, to step into the case and so obscure the issue that only a commission with more than the average of political courage would be willing to give its engineers the support they deserve.

The fear is being expressed frequently that the difference in cost between steam and hydro has reached the point where those in the business prefer going ahead with plants of the former character than going through the mudslinging of a political fight in order to secure the necessary rights to develop waterpower.

Railway Construction

Leonor F. Loree has revived his project for building a line across the Alleghanies extending from Easton to Alle-

gheny City, Pa., 283 miles, to provide a short, low-grade route for through traffic between New York and Chicago. Mr. Loree has permitted this plan to hang fire for three years, although reminded by the Interstate Commerce Commission from time to time that the original application of his New York, Pittsburgh & Chicago Railroad filed March 30, 1925, would be dismissed unless he was ready to proceed without further delay. The case has been assigned by the commission for further hearing on Dec. 17 at Washington upon receipt of notice from Mr. Loree that he is ready to lay the project before the commission again.

Last spring Loree's company retained John M. Rudiger, locating engineer on the Andean Railroad in Chile, who had expressed confidence, so Mr. Loree told the commission, that a summit level some 250 ft. lower than that figured on in Mr. Loree's original plan would be possible. On Nov. 12 Mr. Loree informed the commission that after reconnoissance of the territory between the Susquehanna River and Indiana, Pa. Mr. Rudiger had suggested some alterations without departing greatly to one side of the proposed line. Lengthening of a tunnel would provide a summit level of about 1,500 ft., which would make the Alleghany crossing lower than that of any other railroad except the New York Central.

Washington Traffic Planning

Efforts are being made by traffic engineers and transportation experts to induce the government officials responsible for the carrying out of the $400,000,000 building program in Washington to make adequate plans beforehand for bringing the employees who will occupy these buildings to and from work. Apprehension is felt in some quarters that in providing for the erection of these buildings in concentrated clusters, proper attention is not being given to street widening and extensions to take care of the increased traffic.

Traffic engineers contend that more consideration is being given to park layout work and landscape gardening than to transportation facilities. They believe that the government has an opportunity of making a real contribution to city planning work in connection with the traffic problem.

Secretary Good's Death

The death of Secretary of War James W. Good on Nov. 18 is viewed with particular regret by those interested in the inland waterway development program and other civil engineering activities of the War Department. It is felt that Mr. Good was especially well suited for this work not only because of his interest in it but also because of his long experience in Congress. Having become familiar with departmental procedure by reason of his tenure in office as a Representative from Iowa, it is pointed out that Mr. Good displayed unusual tact and judgment in carrying out the duties of his office. Expressions of regret have been heard from members of Congress to the effect that it will be difficult to find a successor who will be as able to co-ordinate the work of the War Department with other governmental activities as was Mr. Good.

Reforms for Contractors

A report will be submitted within the next several weeks by the allied industries committee of the Associated General Contractors on the standard code that is being drawn up to be used in connection with a trade practice conference proceeding with the Federal Trade Commission. This code will be used as the basic principle of the fair practice rules that the construction industry is endeavoring to work out. Approval of the Federal Trade Commission is expected to be of material benefit in helping to curb certain harmfully practices in the construction industry.

The marble dealers, who will be the first group to go before the commission, plan to test out the effectiveness of making violations of the price shopping agreement come under the provisions of group 1 rules. Group 1 violations are those that the Federal Trade Commission regards as unfair practices irrespective of whether or not they are included in a code. Elements of the industry that break group 1 rules may be proceeded against by the commission even though they may not have agreed to the particular rule concerned.

Other suggestions are being considered by the A.G.C. for correcting the price-cutting evil. One of these proposes that an organization be set up by parties interested in the construction industry for dispensing information on prevailing prices to the general contractors. Under this plan the contractor, after being assured that a certain subcontractor was quoting a reasonable price, would sign an agreement with him to give him the job contingent upon the securing of the award. In this manner the subcontractor whose bid is used as the means of securing the award will be protected against the price-cutting activities of competitors after the general contractor has obtained the job.

Society Calendar

AMERICAN CONCRETE INSTITUTE, Detroit; annual convention, New Orleans, La., Feb. 11-13.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington; annual convention, Atlantic City, N. J., Jan. 11-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; annual meeting, New York City, Jan. 15-17.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago; annual meeting, Seattle, Wash., Jan. 28-30.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington; annual convention, New Orleans, La., Jan. 20-22.

NATIONAL CRUSHED STONE ASSOCIATION, Washington; annual convention, Cincinnati, Ohio, Jan. 20-23.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, Washington; annual meeting, Chicago, Ill., Dec. 4-6.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual meeting, Memphis, Tenn., Jan. 28-30.

TEXAS SANITARIANS' SHORT SCHOOL will be held at Edinburg, Tex., Dec. 3-5. J. R. Mahone, Edinburg, is secretary.

Personal Notes

Major R. D. MATHESON, formerly a teacher at West Point, has been placed in charge of the Sacramento division U. S. Engineers.

DWIGHT S. VIBBERT has been appointed by the board of selectmen town engineer of West Haven, Conn. Mr. Vibbert has for some years done all the engineering work for the town, but the office of town engineer is a newly created one.

E. H. THORNBERRY, assistant chief engineer of the Peoria & Pekin Union Railway, has been appointed chief engineer, succeeding E. I. ROGERS, who has been elected president of the company.

H. R. ERPS has resigned as chief designer with the bridge division of the Michigan State Highway Department to accept a position with the supervising architect's office, Treasury Department, Washington, D. C., as assistant structural designer.

PAUL MOLLER, for the past six years bridge designer for the Alabama State Highway Department and the Alabama State Bridge Corporation, has resigned to accept a position as structural designer for the Cincinnati Union Terminal Company, Cincinnati, Ohio.

HAROLD MCCORMICK, of Waverly, Ohio, has resigned as resident engineer of the state Highway Department and joined the Associated Sales Company, of Detroit, Mich. Mr. McCormick has been connected with the Department of Highways and Board of Public Works of the State of Ohio for the past seven years.

Lieut.-Col. THOMAS M. ROBINS, who has been on duty in the office of the Chief of Engineers at Washington, D. C., has been placed in charge of the South Pacific division, with headquarters in San Francisco, succeeding Lieut.-Col. J. Franklin Bell, whose application for retirement was noted in the news columns of *Engineering News-Record* last week.

Obituary

CHARLES CHAMBERS SMITH, editor and managing director of *Municipal Engineering*, London, England, died suddenly on Oct. 31. He was for some years town surveyor of Sutton, Surrey, including the period when the late W. J. Dibdin carried on some of his studies of the control bed as a method of sewage treatment.

JAMES A. WATSON, patent attorney and civil engineer with offices in Washington, D. C., died on Nov. 13. Mr. Watson was graduated in civil engineering from Lehigh University in 1884 and became a professor of mathematics at Western Maryland College, Westminster, Md. Later he was associated with the Pennsylvania Railroad as civil engineer.

Construction Equipment and Materials

Prizes Offered for Advances in Gas Welding

To encourage developments tending to reduce the cost of gas welding, the Alexander Milburn Company, Baltimore, Md., is offering three annual prizes of $1,000 each to be awarded in 1930, 1931 and 1932 for advances in the art of using illuminating or byproduct gases for cutting and welding purposes. The prizes are offered in the belief that the use or partial use of such gases in place of acetylene would mean an enormous saving and would greatly increase the use of the welding process. Entries are to be submitted in the form of a thesis describing fully the apparatus and formulas used and the results obtained. Awards will be based on the advancement of the welding art as indicated by the results submitted, the breadth of commercial use and the ease of obtaining the gases used, and the commercial possibilities of the process. The contest will be in charge of a committee of three welding authorities, whose names have not yet been announced.

Wood Preservers to Visit Plants

For the 26th annual convention of the American Wood Preservers Association, at Seattle, Wash., Jan. 28-30, it is planned to have a special trip from Chicago, visiting several tie- and timber-treating plants along the Burlington and Union Pacific railroads. During the convention there will be an inspection of treated timber in the waterfront structures at Seattle. The secretary is H. L. Dawson, Chicago.

Lackawanna Orders New Type of Diesel-Electric Locomotives

Designed especially for main line transfer and classification yard switching service, two "three-power" deisel electric locomotives have been ordered by the Delaware, Lackawanna & Western Railroad for service between Hoboken and Secaucus, N. J. On main-line work these engines will operate as straight electric locomotives, taking power from a 3,000-volt direct-current overhead wire. When working off of electrified trackage, they will operate as combination oil-electric, storage-battery locomotives. Each engine will be 47 ft. long, weigh 248,000 lb. and develop 1,640 brake hp. When operated by trolley, they will haul 45 loaded cars at a speed of 20 miles an hour, which will be reduced to 8 miles an hour when operated by oil-electric engine and storage battery.

The batteries, furnished by the Electric Storage Battery Company, will contain 360 cells and weigh 28,000 lb. each. The oil-electric engines will be of Ingersoll-Rand make, while the electrical apparatus will be supplied by the General Electric Company. The locomotives are to be assembled at Erie, Pa., and will be delivered next summer. Their use obviates the necessity for electrifying switching yards and industrial sidings in connection with the conversion of the suburban lines of the railroad to electric operation.

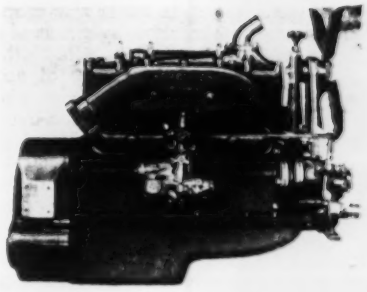
New Developments

Thrust Bearing Used in Chain Hoist

Manufacture of a differential chain hoist has been commenced by Robbins & Myers, Inc., Springfield, Ohio, well known as manufacturers of electrical machinery. The hoist is manufactured in five sizes with capacities ranging from ½ to 2 tons. Timken thrust bearings are used in the lower hook to permit easy turning of the load, thus reducing wear on the chain and upper sheave wheel caused by misalignment of the upper and lower block. The sheaves are made of Aremite, an alloyed iron produced in the Robbins & Myers foundry, which has unusual tensile strength and hardness. A special analysis steel, heat treated and electrically welded, is used in the chain. To minimize corrosion, the entire hoist, except the chain, is given an aluminum finish.

Four-Cylinder Gasoline Motors

To meet the demand for heavy-duty power in the lower horsepower ranges, the Hercules Motor Corporation, Canton, Ohio, has developed a series 00 of three sizes of four-cylinder gasoline engines with bores of 3½, 3¾ and 4 in. and a common stroke of 4½ in. These follow the general design of the larger Hercules motors and develop their maximum torques at 1,000 revolutions per minute and power peaks at 2,200 revolutions per minute. To facilitate the same high-speed operations, special attention has been paid to valve cooling, the valves being completely surrounded by water. A water pump of the centrifugal type is provided, but thermo-siphon cooling may be used if desired. Other features of the motor, in conformance with Hercules practice, include full force-feed lubrication with crankcase ventilation, crankcases cast integral with the cylinder blocks and cast-iron pistons carrying three rings above the pin. Provision is made for either battery or magneto ignition and for the mounting of an electric starter if desired.



CARBURETOR SIDE OF FOUR-CYLINDER MOTOR

Truck Capacity Increased

Eight new chassis types with increased capacity have been added to the model T-60 truck manufactured by the General Motors Truck Company, Pontiac, Mich. These new types are known as T-60 Special, and have capacities ranging up to 22,000 lb. gross weight, including load. The greater carrying capacity has been obtained by the use of heavier worm-drive rear axles, two-stage rear springs and larger tires. Three optional gear ratios are available and four different chassis lengths from 140¾ to 200¾ in. The truck is still powered by the standard Buick valve-in-head six-cylinder motor developing 89 hp. at 2,500 revolutions per minute.

HEAVY-DUTY TRUCK CHASSIS

Light Ditcher Uses Offset Vertical Boom

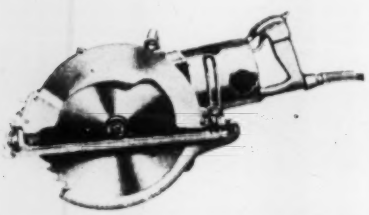
Announcement of the new utility ditcher by the Barber-Greene Company, Aurora, Ill., brings to the light ditcher field a compact, speedy ditcher with an offset vertical boom. The new product is patterned generally after the larger Barber-Greene machines, with several additional features. The machine cuts a trench from 9 to 18 in. wide and from 4 to 5½ ft. deep. It is powered with a Buda 38-hp. gasoline engine driving through two specially designed transmissions, giving four road speeds—three forward and one reverse—and a large number of digging speeds ranging from 12 to 148 in. per minute.

In addition to being vertical in construction, the boom on the utility ditcher

can be offset 13½ in. to either side of the center line of the machine by means of a ratchet and screw. Thus offset, the ditcher can dig within 15 in. of any obstruction. The machine is also equipped with the B-G automatic overload safety sprocket, and is mounted on crawlers by means of a fixed and an oscillating axle which provide three-point suspension. The boom is raised and lowered by power.

Heavy-Duty Portable Saw

For use on heavy construction work, Skilsaw, Inc., Chicago, Ill., is introducing a new model R portable saw carrying a 12-in. blade. This has an adjustable base to regulate the cutting depth, which can be as much as 4⅝ in. A swivel foot with a degree gage is also provided for beveling. Like the smaller Skilsaw model, this machine has an aluminum body, shafts and gears of



PORTABLE SAW FOR HEAVY WORK

chrome nickel steel, and is powered with a universal motor which operates on either alternating or direct current. The operator is protected by an approved safety guard. For bench or table use, the unit is simply turned upside down, no further adjustments being necessary. Besides lumber, the saw will cut metal up to 20 gage, copper cable, lead pipe and, by the use of a carborundum disk, marble, limestone, brick, slate and similar materials. The machine, together with accessories, is packed in a carrying case for easy portability.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Nov. 1,	**1929**	**208.46**	**Oct.,**	**1929**	**273**
Oct. 1,	1929	206.32	September,	1929	340
Nov. 1,	1928	209.46	October,	1928	363
Average,	1928	206.78	Average,	1928	287
Average,	1927	206.24	Average,	1927	263
1913		100.00	1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Nov. 21, with some comparisons, total as follows:

(In Thousands of Dollars)

	Nov. 21, 1929	Nov. 14, 1929	Nov. 22 1928
Buildings:			
Industrial	$5,866	$9,270	$4,733
Commercial	42,410	27,277	34,094
Streets and roads	8,065	12,087	5,978
Other eng. constr.	6,849	17,750	9,574
Total	$63,190	$66,384	$54,379
Total, all classes, Jan. 1 to Nov. 21:			
1929			$3,758,230
1928			3,322,788

Business Notes

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has appointed Arthur C. Allshul manager of its new unit in the Philadelphia, Pa., district, which has been formed as the result of the purchase of the Penn-Jersey Steel Company, of Camden, N. J. Mr. Allshul was formerly manager of the Buffalo plant, where he will be succeeded by Clarence S. Gedney.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., has appointed Thomas Fuller, formerly manager of its Charlotte (N. C.) office, manager of the Atlanta (Ga.) district office to fill the vacancy caused by the death of H. A. Coles.

ATLAS PORTLAND CEMENT COMPANY, New York City, has acquired 1,200 acres of limestone deposits in Olmstead County, Minn., and is planning the construction of a plant to produce 1,000,000 bbl. a year.

CATERPILLAR TRACTOR COMPANY, San Leandro, Calif., has advanced H. H. Chambers, formerly assistant sales manager of the Eastern territory, to the post of sales manager of the Western division, with headquarters at San Leandro. Mr. Chambers succeeds I. E. Jones, now on a foreign trip in the interests of the export sales division. E. I. Stouffer, former district representative in Pennsylvania and New York, becomes assistant sales manager of the Eastern division.

FRUEHAUF TRAILER COMPANY, Detroit, Mich., has acquired control of the Warner Manufacturing Company, Beloit, Wis., which will continue to manufacture trailers as an independent unit with the same management and sales personnel. Administration and production activities of the two companies will be centered at Detroit.

C. O. BARTLETT & SNOW COMPANY, Cleveland, Ohio, has appointed Lloyd R. Wilson manager of sales of ready-mixed concrete bodies. Mr. Wilson was formerly with the Lakewood Engineering Company.

STANLEY ELECTRIC TOOL COMPANY, New Britain, Conn., has purchased the business of the Ajax Hammer Corporation, of New York City.

BAY CITY SHOVELS, INC., Bay City, Mich., has added a new office building and a new assembly building to its plant facilities.

SULLIVAN MACHINERY COMPANY, Chicago, Ill., has recently completed an addition to its plant at Michigan City, Ind.

New Publications

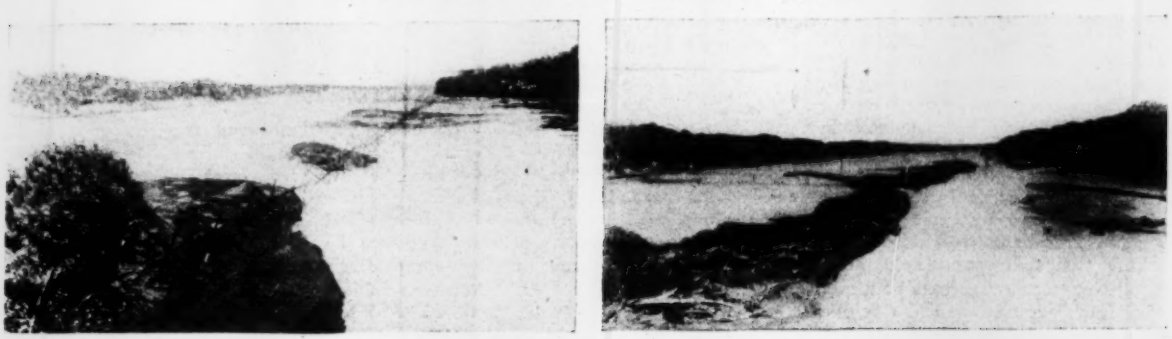
Steel Roofing—TRUSCON STEEL COMPANY, Youngstown, Ohio, has issued a 16-p. illustrated booklet, "Erection Data and Specifications on Truscon Ferrobord Armco Ingot Iron Roofdeck." This gives directions for the economical installation of Ferrobord roofdeck, which comes in 6-in. board-like sections.

Stone and Gravel Machinery—SMITH ENGINEERING WORKS, Milwaukee, Wis., has issued a new general catalog, 266-F, describing Telsmith screens, washers, conveyors, elevators, bin gates and other apparatus for the treatment of sand, stone and gravel. The catalog contains 27 pages and is handsomely illustrated.

Oil Engines—CONTINENTAL GIN COMPANY, Birmingham, Ala., has issued a 47-p. illustrated catalog describing one-, two-, three- and four-cylinder engines rated from 42 to 225 hp. operating on the two-cycle, airless injection, simplified diesel principle. The text gives an unusually clear exposition of the operation of these motors.

Pipe Welding—LINDE AIR PRODUCTS COMPANY, New York City, in a 67-p. booklet, "Design Standards for Oxwelded Steel and Wrought Iron Piping," gives current practice in the design of gas-welded steel or wrought-iron piping systems for all purposes. Subjects treated include line joints, welded flanges, fittings and headers and other pipe details. An appendix gives pipe dimensions, expansion tables, strength tables and considerable other data on piping. This book will prove valuable to all interested in industrial piping.

STREAM CONTROL BY MEANS OF JETTIES



Changes in the regimen of rivers often threaten engineering structures, such as railroads, highways and bridges. A system of control by means of groups of jetties, each made of three angles connected at their centers at right angles and tied together by means of wire cables, has been developed by the Kellner Jetties Corporation, Topeka, Kan., which has been very successful in controlling erosion and in building up riverbanks. These two photographs, taken in 1920 and 1929, show the results obtained on the Kansas River at Topeka, Kan., where it was necessary to cut away a bar (shown on the extreme right) and to divert the main river channel toward the intake of the city water department. The effective work of the jetties in accomplishing these purposes is shown in the second photograph. The Kellner Jetties Corporation has made a special study of river regulation.